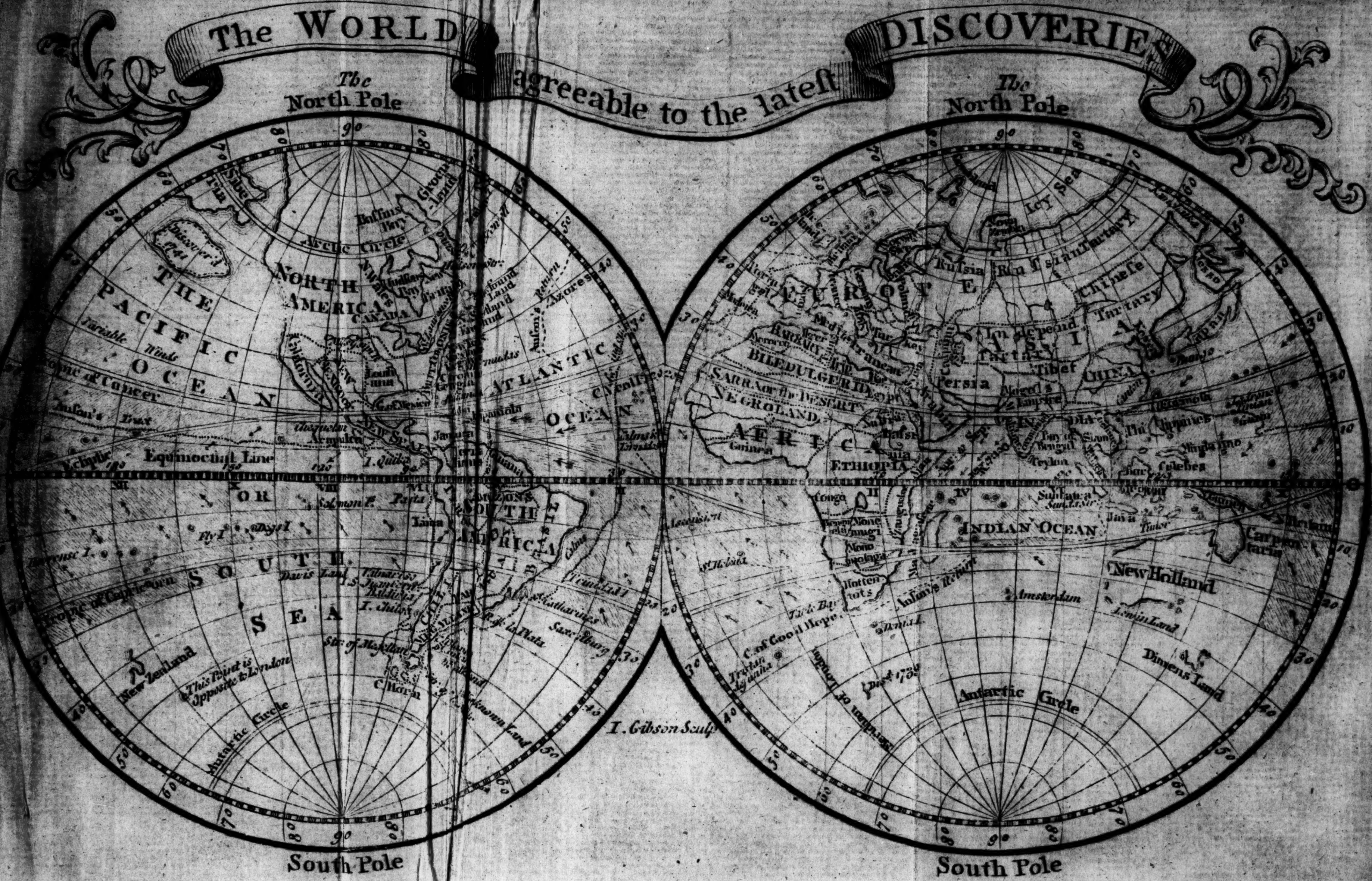

The WORLD agreeable to the latest DISCOVERIES

I. Gibson Sculp

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A New and Eaſy GUIDE to The USE of the GLOBES; AND THE Rudiments of Geography.

WHEREIN

The Knowledge of the HEAVENS and EARTH is made eaſy to the meaneſt Capacity: Firſt, by giving a conciſe Account of the four Quarters of the World, with the Diſtance and Situation of the principal Iſlands and inland Places; and Secondly, by the Solution of upwards of Seventy uſeful Problems, in *Geography*, *Aſtronomy*, *Navigation*, and *Dialling*.

In which are inſerted

THREE uſeful TABLES.

I. Shews the Latitude and Longitude of the principal Places from the Meridian of London.

II. Shews the Sun's Place, Declination, Time of Riſing and Setting; Length of Days and Nights, and Beginning and Ending of Twilight every Week, according to the New Style.

III. Shews the Latitude, Longitude, Right Aſcenſion, and Declination of the moſt eminent fixed Stars.

To the whole is ſubjoined

AN APPENDIX;

Containing a ſhort Account of the SOLAR SYSTEM, and of the COMETS and FIXED STARS.

By DANIEL FENNING,

Author of the School-Maſter's Uſeful Companion, or Scholar's beſt Inſtructor; the Royal Engliſh Dictionary, publiſhed by the King's Authority; the Britiſh Youth's Inſtructor, or, a New and Eaſy Guide to Practical Arithmetic; and the Young Man's Book of Knowlege.

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BRITISH MUSEUM
14 JUL 51

DEDICATION.

To all public Tutors and Lovers of Mathematical Learning, eſpecially thoſe that I have had the Honour to inſtruct.

THE Study of the Uſe of the Globes is now become very common among Gentlemen, in compariſon of what it was ſome few Years ago; and there are Numbers that cannot bear the Thought of going through a tedious and regular Courſe of Geometry, Trigonometry, Algebra, &c. yet find a great Pleaſure in learning upon the Globes; and this I imagine is becauſe the Knowlege of them is ſo readily attained. Nothing is eaſier than practical Geography, commonly called The Uſe of the Globes; becauſe no other Branch of Learning is previouſly neceſſary. He that can read well, may arrive at the Knowlege of them almoſt as ſoon as another that is well acquainted with Figures.

Some of you may think it a Preſumption in me to publiſh a Book upon the Uſe of the Globes, when ſo many are already extant upon the ſame Subject, and eſpecially as Dr. Harris's is ſo much uſed: But many of you are ſenſible I have been obliged to explain him to you; and you have owned he is not ſo clear in many of the Problems as could be wiſhed. Beſides, his is a general Treatiſe of the Rudiments of Aſtronomy, mixt with the Uſe of the Globes; but this little Tract, except in the Appendix, treats of Nothing of that Sort, but goes through a Series of Problems (as you will ſee more particularly in the Preface) Step by Step; and as every Problem has an Anſwer, you cannot be at a Loſs to know when you are right.

As I have endeavoured to render it both eaſy and uſeful in all public Academies, &c. as well as to private Gentlemen, you will, no Doubt, excuſe ſome few Errors; and in giving it a kind Reception you will do me great Honour, and very much oblige,

Your humble Servant,

D. Fenning.

BRITISH MUSEUM 11 JUL 51

PREFACE.

Kind Reader,

I Here preſent you with a ſmall Treatiſe of Geography and The Uſe of the Globes.

The Geographical Part, you may very juſtly ſuppoſe, I borrowed from different Authors, who, no Doubt, were obliged in the ſame Manner to borrow their Accounts from previous Publications: And this is always allowable in Hiſtory, though not in every Part of Learning.

Beſides, many Hundreds may happen on one Book, who may never ſee another on the ſame Subject; therefore a Number of Books can never fail of being ſerviceable to the Public; and if every Author makes but an Improvement in what he takes in Hand, he does well, and the Reader is in ſome Meaſure obliged to him. It may be aſked what Improvements can be made here, ſince there are ſo many large Volumes upon the Subject, and theſe written by the moſt eminent Authors? I anſwer, that as my Knowlege is not ſufficient, ſo my Intention never could be to give a better Account of Things than they have done. But the Point in Hand is, whether I have not drawn the Work into a narrower Compaſs, ſo as not to burthen the Memory, and yet, at the ſame Time, made it ſo diſtinct as to convey a clear and ſatisfactory Idea of what is both neceſſary and uſeful to every common Reader. If I have in any Reſpect done this, I have done as much in the Geographical Part as I intended, and more; for my Deſign at firſt was only to treat of the Deſcription and Uſe of the Globes; therefore I hope, if any Errors have crept into the firſt Part, they will be pardoned. For

---

Some Authors differ from others. Thus Gordon ſays, that the Metropolis of Maryland is Baltimore, in Honour of Lord Baltimore; but Taylor and Dampier ſay Annapolis-Royal is the Capital.—Which of theſe are right I cannot determine; only this I ſay, that Gordon

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Gordon ſeems to be right according to Hiſtory, and Taylor according to Cuſtom; becauſe Annapolis-Royal is the chief Place of Traffic and Buſineſs. But I leave this to better Judges, and will give ſome Account of the Work in general.

Dialogue I. II. III. and IV. Contain a ſhort and eaſy Account of the Situation of the principal Places in the known World, with their Diſtance from London, in an Arch of a great Circle.

Dial. V. and VI. Contain a general Deſcription of the Globes, with the Nature and Property of the Sphere, and the different Situation of the Inhabitants of the World in reſpect of each other.

Dial. VII. An explanation of the moſt uſeful Terms in Geography; to which are annexed, Three uſeful Tables.

1. Shews the Latitude and Longitude of the principal Places from the Meridian of London.

2. Shews the Sun's Place, Declination, Time of riſing and ſetting, &c.

3. Shews the Latitude and Longitude, right Aſcenſion, &c. of the moſt eminent fixed Stars, taken from Senex's Globes.

Dial. VIII. Contains 77 Problems performed by the Globes, many of which are very uſeful in ſhewing the Nature of Spherical Triangles, and are applied to Navigation, Dialling, &c. and I have not only given you the Rule to work them by, but have given you the Anſwers to the Problems, that you may know when you are right. If indeed your Anſwer be not exactly the ſame with mine in Reſpect to Minutes, never mind that; for I have taken the neareſt Quarter of a Degree for the Anſwers in general: Thus, if it were 12 Minutes, I call it 15 or ¼ of a Degree. I have done the ſame when it is 20 Minutes, but if it be near ½ a Degree on the Quadrant, I call it 30 Minutes; and this I have done on Purpoſe to avoid puzzling the Learner, becauſe we cannot gueſs to a Minute or two on the Quadrant, and Globes will often differ, for want of good Appendants.

As for the Diſtance of Places from London, I have taken it from no Book or Perſon; and though I agree with Echard, and ſeveral others, in Reſpect of Degrees, yet I differ from them in my Anſwer in Miles, moſt of them allowing but 60 Miles or Minutes to a Degre[illegible]nd I have counted 69½ to a Degree. If you cannot multiply the Degrees by 69½, then multiply by 70, and take ½ the Number of Degrees out of that Product, it is the ſame as multiplying by 69½.

In fine, I have endeavoured to render it is as uſeful as I could, and I am perſuaded any body may (of himſelf) learn the Uſe of the Globes by it, if he will but take the Trouble to learn the Signs and Terms previous to ſuch an Undertaking.

Arts and Sciences are not learnt by ſolitary Reading only; there muſt be ſome Practice, or elſe the bare Reading will never make a complete Artiſt; and if ſo, how can it be expected that he ſhould become a Proficient that never reads at all.

It is not having a Thouſand Volumes in your Library, that will convince the World you underſtand them; for, without a little Pains, you will never be a Jot the wiſer in the practical Part of the Mathematical Studies.

But as for the Uſe of the Globes, it is ſo eaſy and ſo natural, that moſt Perſons eſteem it as a Pleaſure, rather than a Labour; and as the Knowledge of them is very uſeful as well as entertaining, I would recommend it to young Gentlemen in general, as they may learn the Uſe of them without Pains, and, in ſhort, without Loſs of Time.

To render the Work ſtill more perfect, I have added an Appendix, containing a ſhort Account of the Solar Syſtem, and of the Comets and fixed Stars.

I am, kind Reader,

Your humble Servant

and Well-wiſher,

D. FENNING.

BRITISH MUSEUM

TO THE

PUBLIC.

WE whoſe names are hereunto ſubſcribed, having peruſed this epitome of Geography, do allow it to be very well adapted to the capacity of all ſuch as would acquire a true and ſpeedy notion of the ſituation of the principal places in the known world. And for the variety of Problems it contains, and which are ſo eaſily ſet forth, and ſo plainly demonſtrated, we beg leave to recommend it to every learner, as the moſt uſeful book extant. Witneſs our hands,

George Coles, *Surveyor.*
Henry Deacon, *Accomptant.*
Edward Griffiths, *Surveyor and Accomptant.*
Anthony Gilbert, *Surveyor.*
Abraham De Lire, *Philo. Math.*
John Quant, *Teacher of the Mathematics.*
William Simſon, *Philo. Math.*
John Smythe, *Accomptant.*
James Thurſton, *Ditto.*

To the RECOMMENDERS.

GENTLEMEN,

I Return you hearty thanks for your kindneſs in honouring me with your names to this ſmall Treatiſe. Your aſſiſtance in diſcovering any errors that I have omitted correcting, will ſtill further oblige,

GENTLEMEN,

Your very humble ſervant,

Daniel Fenning.

Juſt publiſhed,

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1. Contains the names of the principal men, mentioned in the Old Teſtament, with their original meaning, and the place where they are found.

2. The names of ſuch places as are moſt difficult to read and pronounce; theſe have here both their proper accent, and rules of pronunciation, for ſuch as would read the ſacred ſcriptures with propriety.

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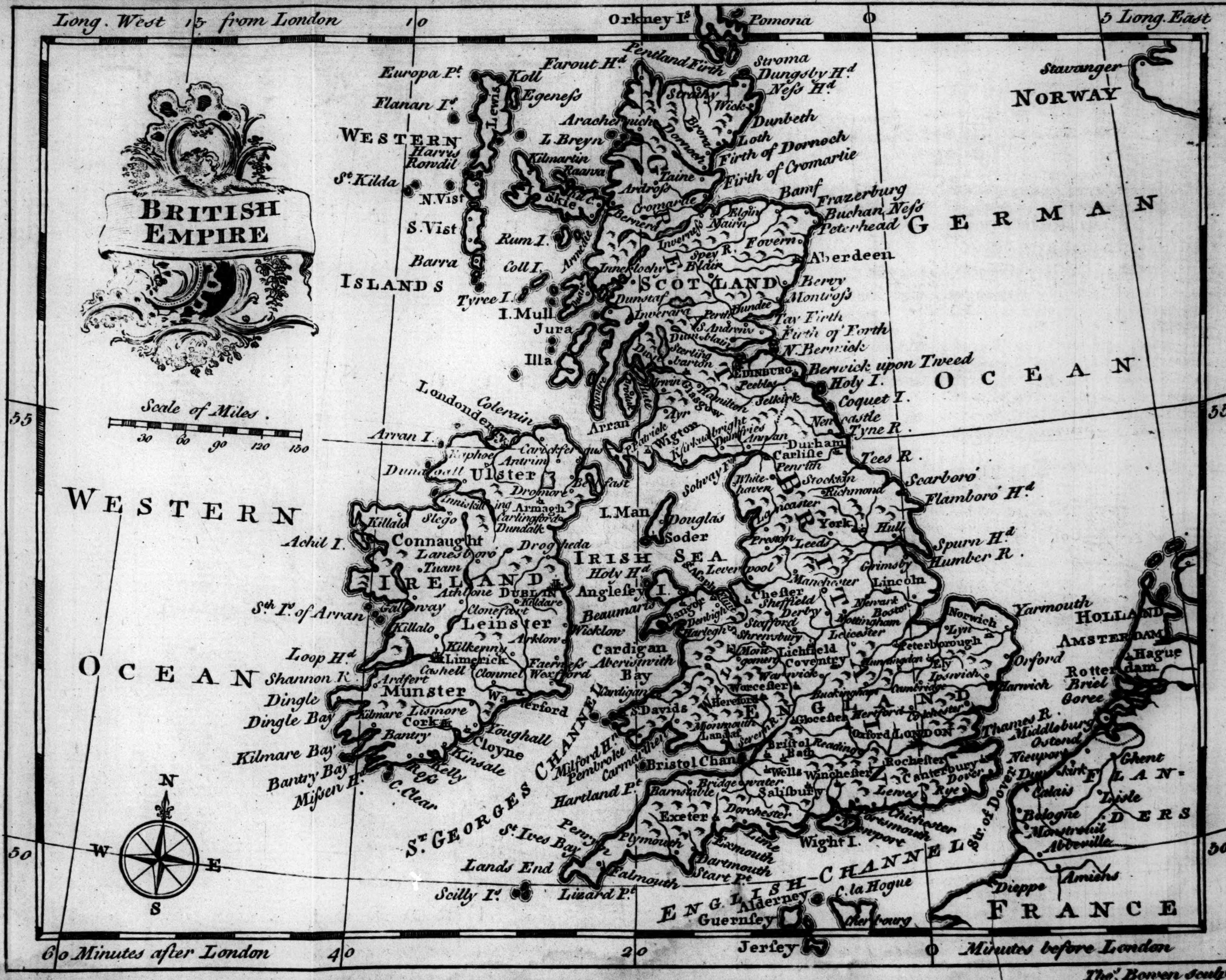

BRITISH EMPIRE

Thos. Bowen sculp.

A NEW and EASY GUIDE TO THE USE of the GLOBES.

DIALOGUE I.

Between PHILO, *a Tutor, and* TYRO, *a Pupil, concerning* GEOGRAPHY *in general.*

SECT. I.

Tyro. YOU have already been ſo kind, dear *Philo*, as to inſtruct me in the principles of common arithmetic, and the rudiments of algebra, and you promiſed to inſtruct me alſo in the uſe of the globes: if therefore it be agreeable to you, I ſhould be very glad to begin immediately.

Philo. With all my heart; it pleaſes me much to ſee you delight in any thing of this ſort, rather than ſpend your time in idleneſs, which is the parent of miſchief; I am therefore as ready to teach you as you are willing to be taught: but I think it would not be amiſs to give you firſt a little notion of geography, as it will not only the better qualify you for this undertaking, but will be a great help to you for the more ready underſtanding whatever you read.

Tyro. I thank you, ſir; for indeed I have very little notion of, and ſcarce know what you mean by, geography.

Philo. Geography is a ſcience which explains and teaches the properties of the earth, both in reſpect to land and water; for of theſe two parts the terraqueous globe is compoſed.

Tyro. You ſay the earth is a globe: I ſhould be glad to be informed how it is poſſible to know of what figure the earth really is.

Philo. The roundneſs of the earth may be ſhewn from many obſervations: 1. When we are on board a ſhip at ſea, we may be out of ſight of land, when the land is near enough to be viſible, if it were not hid from our eye by the convexity of the water. In this caſe, the tops of hills, cliffs, ſteeples, towers, &c. firſt appear to our view, next the buildings, and laſt of all the ſhore; which can proceed from nothing elſe than the roundneſs of the earth, whereby the lower objects are longer hid from the ſight, than thoſe which are higher.

2. The

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2. The higher the eye is, the farther will the view be extended: it is very common for ſeamen on the top of the maſt, to diſcover land, or ſhips, at a greater diſtance than thoſe can do who ſtand upon the deck; the object being hid from the latter by the convexity of the water. 3. When we ſtand upon the ſhore, the higheſt part of a ſhip is viſible at the greateſt diſtance: if a ſhip is going from us out to ſea, we ſhall continue to ſee the maſt, after the hull or body of the ſhip diſappears, and the top of the maſt will be ſeen longeſt. But if the ſurface of the ſea were a flat, every part of an object would be equally viſible; and not the higheſt, but the largeſt parts of an object, would be viſible at the greateſt diſtance, ſo that we ſhould be able to ſee the hull of a ſhip farther off than the maſt: But this is contrary to experience; conſequently the earth is round. 4. The convexity of the water may be ſeen in calm weather, and where the fluid is unruffled by the agitation of the ſtream, provided it be a mile or two in a ſtraight line, for a little boat upon the water may be ſeen by a perſon whoſe eye is a ſmall height above the water; but if he ſtoops down and lays his eye near the ſurface, he will find that the boat is covered by the convexity of the water. 5. Several navigators have ſailed quite round the earth; not in an exact cir-

cle, the winding of the ſhores preventing them from ſailing on a direct courſe; but by ſailing continually to the weſtward, they have reached the place from whence they at firſt departed. This was performed by Magellan, Cavendiſh, Sir Francis Drake, Lord Anſon, Bougainville, Commodore Byron, the Captains Carteret, Wallis, Cook, and others. 6. All the appearances of the heavens, both at land and ſea, are the ſame as they would be were the earth a globe, which proves that it is really ſuch: And, laſtly, eclipſes of the moon, which are cauſed by the ſhadow of the earth falling on that planet, demonſtrate that the earth is of a globular figure; for this ſhadow is always circular, whatever ſituation the earth may be in at that time: Now a body muſt be globular, which always caſts a circular ſhadow. Nor are the little unevenneſſes on the earth's ſurface, ariſing from hills and valleys, any material objection to its being conſidered as a round body; becauſe the higheſt mountains bear a leſs proportion to the bulk of the earth, than the little riſings on the coat of an orange, bear to that fruit; or a grain of ſand to an artificial globe, of nine inches diameter: and accordingly, we find that the mountains and valleys on the ſurface of the earth, cauſe no irregularities in the ſhadow, during a lunar eclipſe; the circumference thereof being even and regular, appearing as if caſt by a body truly globular.

Tyro. I am convinced from the reaſons you have given, that the earth is round; and ſhould be glad to know the methods that have been taken to meaſure it, or find the dimenſions of this globe.

Philo. The methods made uſe of to meaſure the earth are very plain and eaſy to be underſtood. But it will be neceſſary to obſerve, that every great circle, and conſequently the circumference of the earth, is divided into 360 equal parts called degrees, and every degree into 60 equal parts called minutes, &c.

Tyro. This I have already learned in common arithmetic; but ſhould beglad to know why every circle contains neither more nor leſs than 360 degrees.

Philo. It was abſolutely neceſſary that ſome certain number ſhould be fixed upon, and the ancients choſe the number 360 for no other reaſon, than its being diviſible into many equal parts: thus its half is 180, its quarter 90, and its half quarter 45; an advantage that few other numbers can boaſt of, eſpecially as the three firſt end with a cypher.

Tyro. You have ſufficiently ſatisfied me in this particular; and now I am prepared to underſtand the method made uſe of in meaſuring the earth.

Philo. As every circle is divided into 360 degrees, if at two places ſituated North and South of each other, the altitude of the ſun be taken on the ſame day at noon, and the ſun be found to be one degree nearer to the zenith at one place than at the other, thoſe two places are one degree aſunder. Now if the diſtance between theſe two places be meaſured by a chain or otherwiſe, we ſhall know the length of a degree, and conſequently of any part of a degree in Engliſh meaſure. This has been done by ſeveral geographers, particularly by our countryman Mr. Richard Norwood, who, in the year 1635, obſerved the difference of latitude, and meaſured the diſtance between London and York. By which it appeared that 367200 Engliſh feet, or 69 miles and a half, and 14 poles, make a degree. Hence the whole circumference of the globe will be 25,038, and its diameter 7,970 Engliſh miles, reckoning 69 and a half to a degree.

The map of the world, prefixed to this work, will give you a much better idea of the world itſelf, than the beſt verbal deſcription. It repreſents the artificial globe taken out of its horizon, ſqueezed flat, cut through, and the two hemiſpheres placed cloſe to each other.

Tyro. Into how many parts is the earth divided?

Philo. Into 4 parts, or quarters; viz. 1. Eu-

1. Europe, 2. Aſia, 3. Africa, and 4. America.

Tyro. What are the other nominal parts of the earth; or how is it yet further divided in relation to land and water?

Philo. It is divided into 10 different parts; 5 belonging to land; viz. 1. A continent. 2. An iſland. 3. A promontory or cape. 4. A peninſula. And, 5. An iſthmus. The other 5 belonging to water; viz. 1. An ocean. 2. A lake. 3. A bay. 4. A gulph. And, 5. A ſtreight. Theſe anſwer to each other, as more plainly appears by the following deſcription.

LAND.	WATER.
1. A continent is a large tract, or vaſt extent of main land, not ſeparated by any ocean. Thus Europe, Aſia, Africa, &c. are continents.	1. An ocean (or ſea) is a large extent or collection of waters, free from land; ſuch as the Atlantic or Weſtern Ocean, the Indian Ocean, &c.
2. An iſland is a tract of land ſurrounded with water: as Great Britain, Ireland, Madagaſcar, &c.	2. A lake is a tract of water ſurrounded by land: as the lake of Geneva, the Dead Sea, the Caſpian Sea, &c.
3. A promontory, or cape, is a portion or part of land running far into the ſea; as Cape Verde, Cape of Good Hope, &c.	3. A bay is a portion or part of the ſea running far up the main land; as the Bay of Biſcay, Bay of Siam, &c.
4. A peninſula is a part or portion of the earth almoſt ſurrounded with water, ſave only a narrow part or neck of land which	4. A gulph (or inland ſea) is a part of the ocean almoſt ſurrounded with land, ſave ſome ſtreight or narrow gut of water, by

LAND.	WATER.
joins or unites it to a continent: as Africa itſelf, Jutland, &c. &c.	which it has a communication with the ocean; as the Gulph of Arabia, the Mediterranean Sea, &c.
5. An iſthmus is a narrow part of land, by which a peninſula is joined to a continent, or main land; at the iſtmus of Panama, which joins North and South America together; the iſthmus of Corinth, &c. &c.	5. A ſtreight is a narrow paſſage or part of the ſea, which joins one ſea to another; as the ſtreights of Gibraltar, which join the Mediterranean Sea to the Atlantic Ocean; the ſtreights of Babelmandel, &c. &c.

SECT. II.

A further deſcription of the four quarters of the world; and,

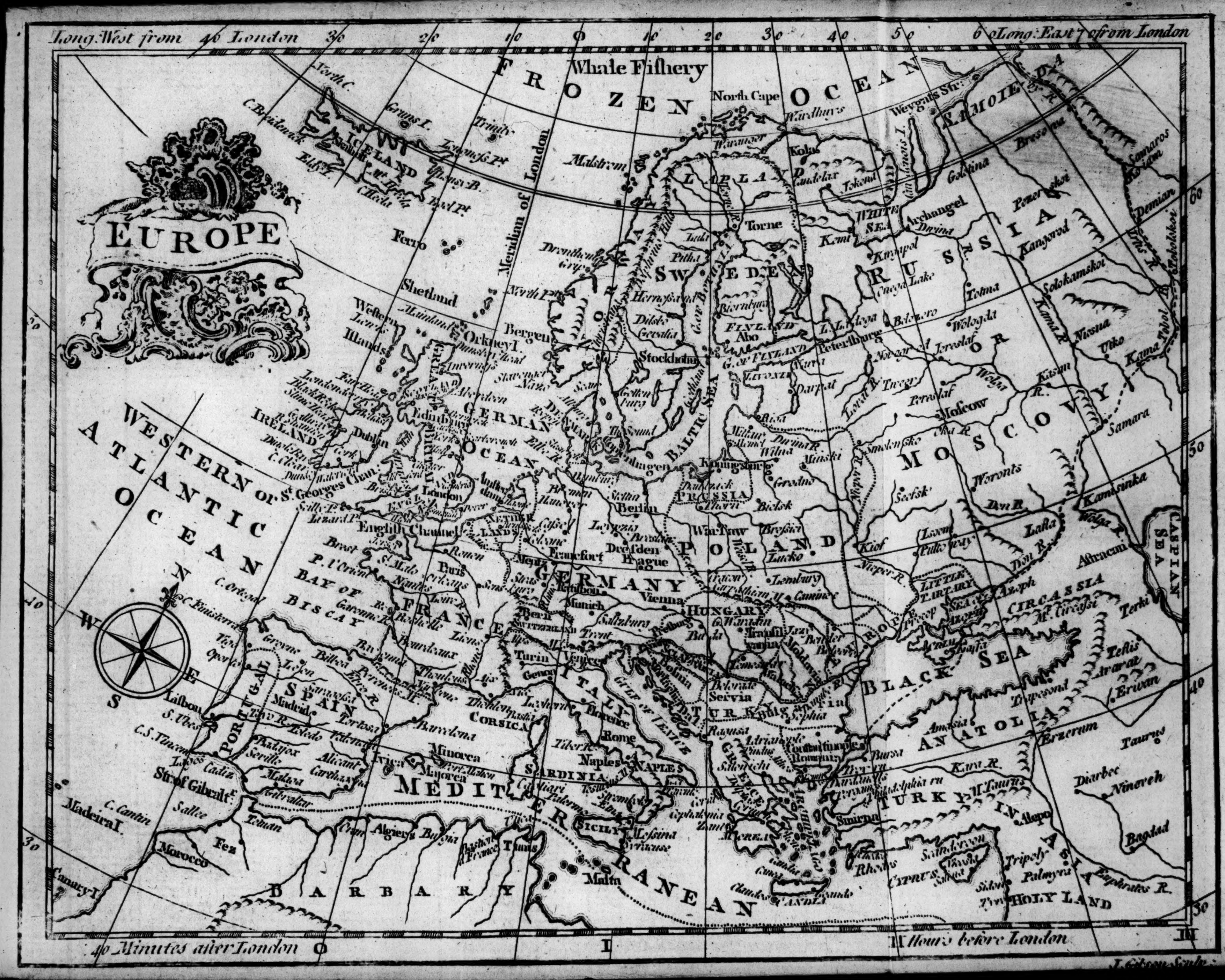
I. Of EUROPE.

Tyro. WHAT are the principal kingdoms or parts into which Europe is divided?

Philo. They are 9 in number; viz. 1. Scandinavia (which contains Sweden or Swedeland, Denmark, and Norway.) 2. Muſcovia, or Ruſſia. 3. France. 4. Germany. 5. Poland. 6. Spain. 7. Italy. 8 Portugal. And, 9. Turkey.

Tyro. Pray give me ſome ſhort account of theſe with reſpect to their ſituation on the globe, and to each other.

Philo. That I will, my dear pupil; but it muſt be but a ſhort account indeed; juſt enough



J. Gibson Sculp.

enough to give you a little idea of the matter, and qualify you the better for reading and converſation. But the map of Europe, which you ſee before you, will be of the greateſt uſe; and the ſituations of places will be much eaſier obtained from thence than from any verbal deſcription.

I. Of SCANDINAVIA.

Tyro. What do you mean by Scandinavia; and how, or whereabouts is it ſituate?

Philo. Scandinavia is a large continent, ſituate between 54 and 72 degrees of N. latitude; under which name is comprehended the kingdoms of Sweden, Denmark, and Norway, as was ſaid before.

1. Sweden.

Tyro. How is Sweden ſituate?

Philo. Sweden is bounded on the N. and W. by Norway, on the E. by Muſcovy, and on the S. by the Sound, and part of the Baltick. Its metropolis or chief town is Stockholm, whoſe diſtance from London is about 12 $\frac{3}{4}$ degrees; viz. 886 miles N. E. The longeſt day in the moſt northern parts of this country is about two months, and the ſhorteſt in the moſt ſouthern parts about 6 $\frac{1}{2}$ hours.

2. Denmark.

Tyro. How is Denmark ſituate?

Philo. Denmark is bounded on the N. by the Sound, on the E. by the Baltick, on the S. by part of Germany, and on the W. by the German Ocean. Its metropolis is Copenhagen, whoſe diſtance from London is 610 miles N. E. The length of the longeſt day in the moſt northern parts of this country is about 17½ hours; and the ſhorteſt in the moſt ſouthern about 6½ hours long.

3. NORWAY.

Tyro. How is Norway ſituate?

Philo. Norway is bounded on the N. W. and S. by part of the Main Ocean, and on the E. by Sweden and the Gulph of Bothnia. Its metropolis is Bergen, whoſe diſtance from London is about 9¼ degrees; viz. 642 miles N. by E. The length of the longeſt day in the moſt northern parts is above 2 months, and the ſhorteſt in the moſt ſouthern about 6 hours.

II. *Of* MOSCOVY *or* RUSSIA.

Tyro. How is Moſcovy ſituate?

Philo. Moſcovy is bounded on the N. by the great Northern Ocean, on the E. by Tartary, on the W. by Sweden, and on the S. by the Caſpian Sea, and part of Little Tartary and Georgia. Its length is computed to be about 1500 miles, and breadth about 1100 miles. Its chief province is

Moſcovy, and its ancient metropolis Moſcow, whoſe diſtance from London is about 23 degrees; viz. is nearly 1600 miles N. E. and about 800 E. of Cracow. Its preſent metropolis is Peterſburg. The longſt day in the moſt northern parts of this country is about 2 months, and the ſhorteſt in the moſt ſouthern is about 9½ hours.

III. *Of* FRANCE.

Tyro. How is France ſituate?

Philo. France (called Gallia, or the country of the ancient Gauls) is bounded on the N. by the Engliſh channel, on the E. by Germany, on the S. by part of Spain and the Mediterranean Sea, and on the W. by the Bay of Biſcay. Its length is computed to be 600 miles, and its breadth 500. Its metropolis is Paris, whoſe diſtance from London is about 3 degrees S. S. E. viz. 210 miles. The length of the longeſt day in the moſt northern parts of this kingdom is about 16¼ hours, and the ſhorteſt in the moſt ſouthern part 9¼ hours.

IV. *Of* GERMANY.

Tyro. How is Germany divided?

Philo. Germany is in length about 700 miles, and breadth about 600. It is divided into three parts; viz. Holland, Flanders, and Upper Germany.

1. HOLLAND.

Tyro. How is Holland ſituate?

Philo. Holland is bounded on the N. and W. by the German Ocean, on the E. by Upper Germany, and on the S. by Flanders. Its metropolis in the N. part is Amſterdam, whoſe diſtance from London is about 210 miles N. E. and Rotterdam in the S. which is about 190 E. from London.

2. FLANDERS, *or the* AUSTRIAN NETHERLANDS.

Tyro. How is Flanders ſituate?

Philo. Flanders is bounded on the N. by Holland, on the E. by Upper Germany, on the S. by France, and on the W. by the German Ocean. It has many fair and rich provinces, the metropolis of which is Bruſſels, whoſe diſtance from London is about 160 miles E.

3. UPPER GERMANY.

Tyro. What do you mean by Upper Germany, and how is it ſituate?

Philo. Upper Germany is that part of Germany properly ſo called, and part of ancient Gaul and Italy. It is bounded on the N. by Denmark and part of the Baltick, on the E. by Poland, on the S. by Italy, and on the W. by France. Its metropolis is Vienna, whoſe diſtance from London is about 640 miles S. E.

V. *Of*

V. *Of* POLAND.

Tyro. How is Poland ſituate?

Philo. Poland is bounded on the N. by Moſcovy and the Baltick, on the E. by Little Tartary and part of Moſcovy, on the S. by Hungary, Tranſilvania and Turky, and on the W. by Upper Germany. Its length is about 700 miles, and breadth about 680. Its metropolis is Warſaw, whoſe diſtance from London is 21 degrees; viz. about 770 miles E. The longeſt day in the moſt northern part of the country is about 17½ hours, and the ſhorteſt in the moſt ſouthern about 8¾ hours.

Tyro. Is there any thing elſe remarkable with regard to Poland?

Philo. The Poles have been lately ſtript of a great part of their country by the empreſs of Ruſſia, the emperor of Germany, and the king of Pruſſia.

VI. *Of* SPAIN.

Tyro. How is Spain ſituate?

Philo. Spain, formerly called Iberia or Heſperia, is bounded on the N. by the Pyrenean Mountains and the Bay of Biſcay, on the E. by the Mediterranean, on the S. by the Streights of Gibraltar, and on the W. by Portugal and the Atlantic Ocean. Its metropolis is Madrid, whoſe diſtance is better than 11 degrees; viz. about 780 miles S. by W. of London. The longeſt day in the moſt northern parts of this kingdom is about 15¼ hours, and the ſhorteſt in the moſt ſouthern part is about 9¼ hours.

VII. *Of* PORTUGAL.

Tyro. How is Portugal ſituate?

Philo. Portugal is bounded on the N. and E. by Spain, and on the S. and W. by the Atlantic Ocean. Its metropolis is Liſbon, whoſe diſtance from London is better than 14 degrees S. W. by S. viz. about 980 miles. The longeſt day in the moſt northern parts of this country is about 15 hours, and the ſhorteſt in the moſt ſouthern about 9¾ hours.

VIII. *Of* ITALY.

Tyro. How is Italy ſituate?

Philo. Italy is bounded on the N. by part of Germany, and on the N. E. by the Adriatic Sea, or Gulph of Venice, and on the S. and W. by the Mediterranean and part of France. Its metropolis is the city of Rome, the ſeat of papacy, and reſidence of the pope. Its diſtance from London is nearly 13 degrees S. E. viz. about 903 miles.

IX. *Of* TURKEY *in* Europe.

Tyro. How is Turkey ſituate?

Philo. Turkey is bounded on the N. part by Ruſſia and Poland, on the E. by the

Black Sea, and part of Turkey in Aſia, on the S. by the Mediterranean, and on the W. by the Gulph of Venice, and part of Germany. It lies between 36 and 49 degrees N. latitude. Its metropolis is Conſtantinople, whoſe diſtance from London is 23¾ degrees; viz. about 1650 miles E. by S.

The length of this country is about 1000 miles, and its breadth about 900. The longeſt day in the moſt northern part is about 16 hours, and the ſhorteſt in the moſt ſouthern about 9¾ hours.

The diviſion of TURKEY.

Tyro. Is not Turkey divided into different parts?

Philo. Yes, into many, but chiefly into four; viz. 1. Hungary. 2. Greece. 3. Crim and Little Tartary. 4. The Danubian provinces.

1. HUNGARY.

Hungary, though now chiefly under the emperor of Germany, is notwithſtanding a part of Turkey. It is bounded on the N. by part of Poland, on the E. by Tranſilvania, on the S. by Sclavonia, and on the N. by Auſtria. Its chief city is Preſburg, whoſe diſtance from London is about 740 miles S. E.

2. Greece.

Tyro. How is Greece ſituate?

Philo. Greece is bounded on the N. by the Danubian provinces, on the E. by the Ægean Sea, called the Archipelago, on the S. and W. by the Mediterranean. Its chief cities are Athens (or Settines) and Adrianople; the firſt of which is about 420 miles S. W. of Conſtantinople, and the other about 146 N. W. of the ſame. Corinth is about 54 miles W. of Athens; and Thebes, or Stives, is about 45 N. W. of Athens.

3. Little Tartary.

Tyro. How is Little Tartary ſituate?

Philo. Little Tartary is bounded on the N. by part of Moſcovy, on the E. by Georgia, on the S. by the Black Sea, and on the W. by Poland.

Its metropolis is Kaffa, ſubject to the Turks; it ſtands near the Euxine Sea, about 380 miles N. E. of Conſtantinople, and about 500 miles S. of Moſcow.

4. *Of the* Danubian *provinces.*

Tyro. What do you mean by the Danubian provinces? and how are they ſituate?

Philo. They are ſo called, becauſe they chiefly lie upon, or near the Danube, which extends from the Black Foreſt in Germany to the Euxine Sea.

Tyro. How many provinces are there?

Philo. Nine; 1. Tranſilvania. 2. Valachia. 3. Moldavia. 4. Romania. 5. Bulgaria. 6. Servia. 7. Boſnia. 8. Sclavonia. 9. Croatia.

SECT. III.

Of the EUROPEAN *iſlands*; *and*,

I. *Of* ENGLAND.

Tyro. HOW is England ſituate?

Philo. England (called alſo Anglia, Britannia, or Albion) is bounded on the N. by Scotland, on the E. by the German Ocean, on the S. by its own channel, which parts it from France, and on the W. by St. George's or the Iriſh Sea: it lies between 50 and 56 degrees N. latitude: its length is about 320, and breadth about 290 miles: its metropolis is London.

This kingdom contains 38 counties, beſides Middleſex and Cheſhire; this laſt being a county palatine, having the privilege of its own particular judges, counſellors, &c. It has two univerſities, Cambridge and Oxford, 24 biſhopricks, and two archbiſhopricks.

Tyro. Are theſe all the counties in England?

Philo. Yes, excluſive of Wales, which has four circuits, twelve counties, and four biſhopricks. The longeſt day in the moſt northern parts is about 17½ hours, and the ſhorteſt in the moſt ſouthern about 8 hours.

II. *Of* SCOTLAND.

Tyro. How is Scotland ſituate?

Philo. Scotland (called alſo Caledonia) is bounded on the N. by the Caledonian Ocean, on the E. by the German Sea, on the S. by England, and on the W. by the Iriſh Sea and the Atlantic Ocean. It lies between 54 and 59 degrees N. latitude. Its length is about 300, and breadth about 150 miles, and its metropolis is Edinburgh, whoſe diſtance from London is nearly 4½ degrees; viz. about 300 miles N. W. The longeſt day in the moſt northern part of this country is about 18½ hours, and the ſhorteſt in the moſt ſouthern 6½ hours.

III. *Of* IRELAND.

Tyro. How is Ireland ſituate?

Philo. Ireland (called by ſome Britannia Parva, and by others Hibernia) is bounded on the N. by the Caledonian Sea, on the W. and S. by the Atlantic Ocean, and on the E. by St. George's Channel. It lies between 51 and 56 degrees of N. latitude. The length is about 290, and breadth about 150 miles. Its metropolis is Dublin, which is diſtant from London nearly 6¼ degrees; viz. about 240 miles N. W. The length of the longeſt day in the moſt northern part is about 17½ hours, and the length of the ſhorteſt in the moſt ſouthern about 7¾ hours.

SECT. IV.

I. *Of the leſſer* European *iſlands, and firſt of ſuch as lie near* Great Britain.

1. *Thoſe on the* North *are,*

1. THE Orkneys, or Orcades. 2. Shetland.

2. *Thoſe on the* Eaſt *are,*

1. Holy Iſland. 2. Fern Iſland. 3. Cocket Iſland. 4. Sheppy Iſland. And 5. The Iſle of Thanet.

3. *Thoſe on the* South *are,*

1. Portland Iſland. 2. The Iſle of Wight. 3. Portſea Iſland.

4. *Thoſe on the* Weſt.

1. Lewis Iſland. 2. Skye. 3. Mull. 4. Jura. 5. Ila. 6. Bute and Arran. 7. Man. 8. Angleſey. And 9. Scilly.

II. *Of other* European *iſlands, more diſtant from* Great Britain.

1. *The* AZORES.

Theſe iſlands lie W. of England, and are ſubject to the king of Portugal. They are

9 in number; viz. 1. St. Michael. 2. St. Maria. 3. Tercera. 4. Gratioſa. 5. St. George's. 6. Rico. 7. Fyal. 8. Flores. And, 9. Cuervo.

2. *Thoſe of* SWEDEN.

Theſe are 8 in number; viz. 1. Rugen. 2. Bornholm. 3. Oeland. 4. Gothland. 5. Oeſal. 6. Dago. 7. Aland. 8. Ween.

3. *Thoſe of* DENMARK.

Theſe are 9; viz. 1. Zealand. 2. Funen. 3. Langland. 4. Laland. 5. Falſter. 6. Mona. 7. Femeren. 8. Alſen. And 9. Iceland.

4. *Thoſe of* NORWAY.

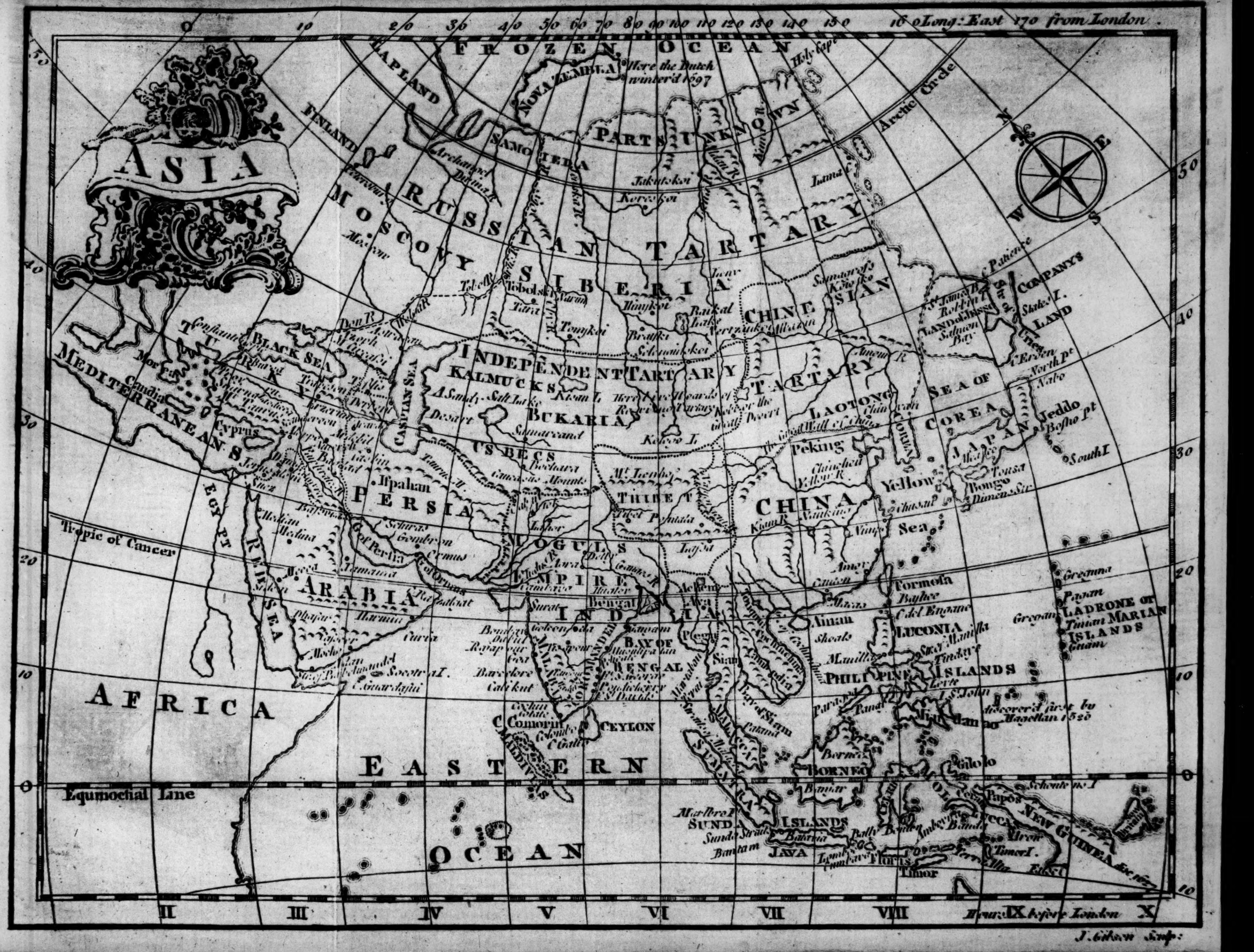
Theſe are 4; viz. 1. Carmen. 2. Hitteren. 3. Sanien. 4. Weroy.

5. MEDITERRANEAN *iſlands.*

Tyro. How many iſlands go under this name? and how are they ſituate?

Philo. There are a great many iſlands, which are ſituate S. of Europe, in or near the Mediterranean Sea; but the following are moſt noted; viz. 1. Yvica. 2. Minorca. 3. Majorca, ſituate W. of Valencia in Spain. 4. Corſica. 5. Sardinia, lying S. of Genoa. 6. Malta. 7. Sicily, lying S. W. of Naples. 8. Cyprus. 9. Candia. And 10. Rhodes, S. of Natolia.

The other ſmall iſlands, as I have obſerved, are of little or no ſignification. Thus much for Europe.



J. Gibson Sculp:

Tyro. I heartily thank you, ſir; and now pray give me a little idea of the other parts of the world.

Philo. I will, but it muſt be but a ſhort hint indeed; though I am willing you ſhould have as much inſtruction as this ſmall tract will allow of. Proceed we then to

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DIALOGUE II.

SECT. I.

Of ASIA.

Tyro. IN what part of the globe is Aſia ſituate?

Philo. Aſia, though called the ſecond, yet is the principal quarter of the globe, lying upon the E part thereof, and extends itſelf from the equator to 72 degrees N. latitude, and is divided into 5 principal parts; viz. 1. Tartary. 2. China. 3. India. 4. Perſia. And 5. Turkey. Theſe parts, as well as the chief ſubdiviſions, are accurately laid down in the map of Aſia, which you ſee before you, and which you ſhould often conſult with attention.

1. *Of* TARTARY.

Tyro. How is Tartary ſituate?

Philo. Tartary is bounded on the N. by the Frozen Sea, on the E. by the Pacific Ocean, on the S. by China, India, Perſia, and the Caſpian Sea, and on the W. by Ruſſia. It lies between 35 and 72 degrees N. latitude, and between the 5. and 26. N. climates; is about 3000 miles long, and 2250 broad, and its chief city is Samarcand. The longeſt day in the moſt northern part is about 2 months, and the ſhorteſt in the moſt ſouthern about 9¾ hours. It is ſubject to the neighbouring nations; viz. the Ruſſians, Turks, and Chineſe, and to the Great Khan of Tartary.

2. *Of* CHINA.

Tyro. How is China ſituate?

Philo. China is bounded on the N. by part of Tartary, on the E. by the Pacific Ocean, on the S. by part of the Indian Ocean, on the W. it has India without the Ganges. It lies between the 3d and 6th N. climates, is about 1400 miles long, and 1260 broad, and its chief city is Pekin, whoſe diſtance from London is 70½ degrees; viz. about 4900 miles S. E. From Pekin to Nankin is about 690 miles S. E. in the former of which is a bell, 11 feet diameter, and 12 feet high, weighing above 53½ tons. The longeſt day in the moſt northern part is about 15 hours; and the ſhorteſt in the moſt ſouthern is about 10¼. It is under the government of its own emperor.

3. *Of* INDIA.

Tyro. How is India ſituate?

Philo. India is bounded on the N. by Tartary, on the E. by China and the Chineſe Sea, on the S. by the Indian Ocean, and on the W. by the ſame Ocean, and Perſia. It lies between 9 degrees of S. and 34 of N. latitude. Its length is about 4000 miles, and its breadth about 2500. It is divided into 3 grand parts; viz. 1. The Great Mogul's empire, containing Delli (his imperial ſeat) Agra, Cambaia, and Bengal. 2. India within the Ganges, whoſe chief kingdoms are Decan, Golconda, Biſnagar, and Malabar.

3. India without the Ganges, whoſe chief kingdoms are Pegu, Tonquin, Cochinchina, Siam, and Malucca. Length of days and nights, in the northern parts, nearly the ſame as in China.

4. *Of* PERSIA.

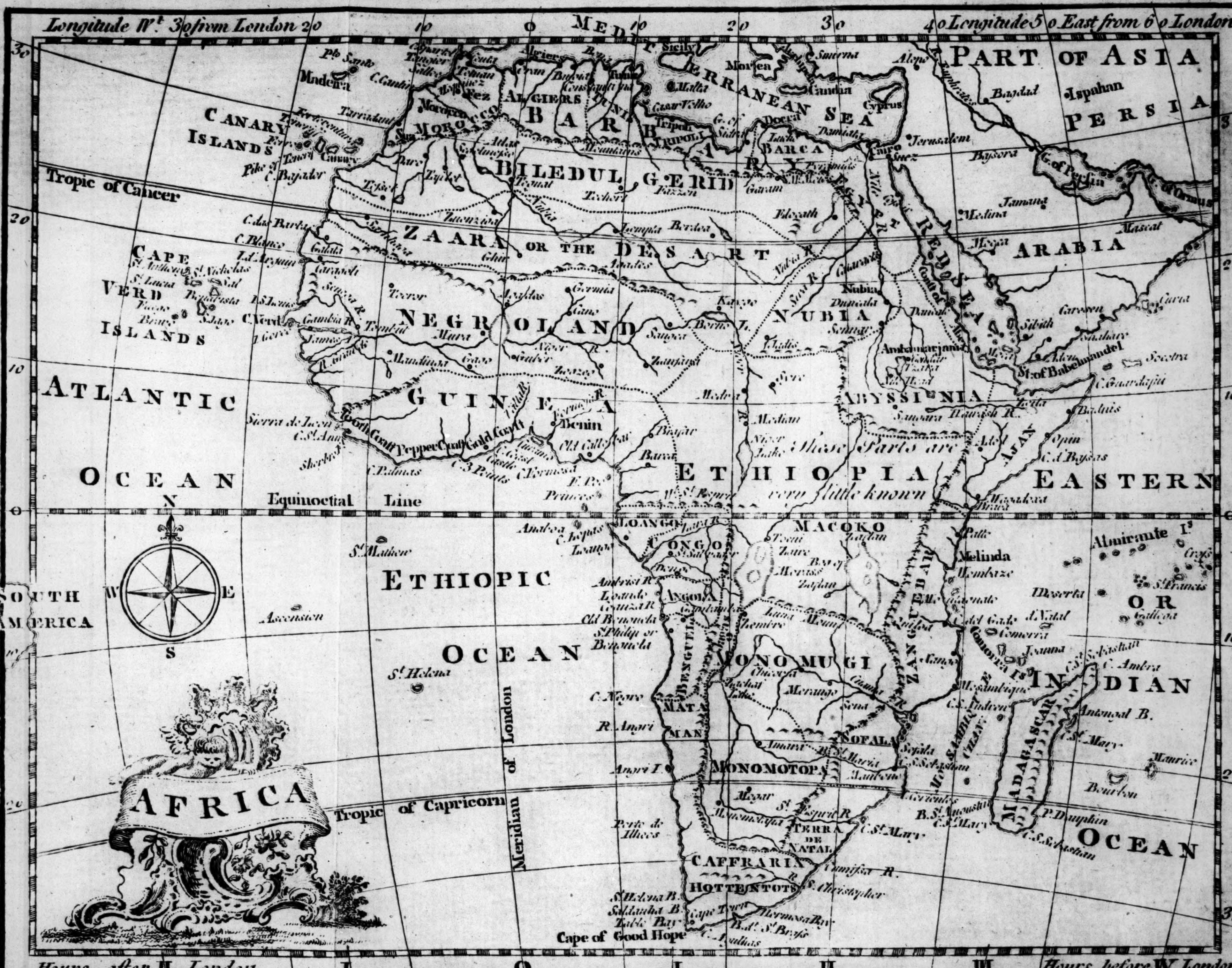
Tyro. How is Perſia ſituate?

Philo. Perſia is bounded on the N. by the Caſpian Sea, on the E. by India, on the S. by the Perſian Gulf, and Indian Ocean, and on the W. by Aſiatic Turkey. It lies between 25 and 45 degrees of N. latitude, and between the 3d and 7th N. climates; therefore muſt of courſe be exceeding hot for many months in the year. Its length is computed at about 1450 miles; its breadth at 1250. It is divided into three parts, N. middle, and S. It is governed by the deſpotic power of the Great Sophy. They are chiefly Mahometans. The longeſt day in the moſt northern parts is about 15¾ hours, and the ſhorteſt in the moſt ſouthern about 10¼ hours.

5. *Of* TURKEY *in* ASIA.

Tyro. How is Turkey in Aſia ſituate?

Philo. Turkey in Aſia is bounded on the N. by the Black Sea, on the E. by Perſia, on the S. by part of Africa, and part of the Indian Ocean, on the W. by the Red Sea, the Mediterranean, and Archipelago. It lies between 12 and 46 degrees of N. latitude; is computed about 2300 miles long, and 2000 broad. It contains ſix great parts; 1. Natolia, whoſe chief city, or town, is Burſa. 2. Arabia, whoſe metropolis is Mecca. 3. Syria, whoſe capital is Aleppo. 4. Diarbeck, whoſe chief city is Bagdat. 5. Turcomania, whoſe capital is Arzerum. And 6. Georgia, whoſe metropolis is Teflis. This vaſt country is inhabited by Chriſtians, Mahometans, Jews, &c. but is chiefly under the Ottoman yoke.



J. Gibson Sculp:

SECT. II.

Of the Aſiatic *iſlands.*

Tyro. HOW many iſlands are here, and how are they ſituate?

Philo. There are a great number, but they are chiefly reduced to theſe ſix, whoſe ſituation is as follows; 1. Japan Iſlands, E. of China. 2. The Philippine Iſlands, S. W. of Japan. 3. The Moluccas, S. of the Philippine. 4. The Sunda, W. of the Moluccas. 5. The Banda, or Nutmeg Iſlands. And 6. Ceylon, W. of the Sunda, whoſe capital is Candia, or Candy. And thus much for Aſia.

DIALOGUE III.

SECT. I.

Of AFRICA.

Tyro. HOW is Africa ſituate?

Philo. Africa, the 3d quarter of the world, and ſituate S. on the globe, is almoſt ſurrounded with the Atlantic, Ethiopian, and Indian Oceans, and is extended from 35 degrees of S. latitude, to about 37 N. It is principally divided into 8 Parts; viz. Egypt, Barbary, Biledulgerid, Zaara, called the Deſart, Negro-Land, Guinea, Nubia, and Ethiopia, beſides Iſlands.

1. Of EGYPT.

Tyro. How is Egypt ſituate and divided?

Philo. Egypt is bounded on the N. by part of the Mediterranean Sea, on the E. by the Iſthmus of Suez and the Red Sea, on the S. by Nubia, on the W. by Barbary and the Deſart. It was formerly called Miſraim. It is divided into Lower Egypt, whoſe metropolis is Grand Cairo; and Upper Egypt, whoſe capital is Sayd. It lies between 21 and 31 N. latitude, and the 2d and 4th N. climates, is about 650 miles long, and 150 broad. It is governed by the Turkiſh emperor, under a Baſſa, whoſe dwelling is at Grand Cairo.

2. Of BARBARY.

Tyro. How is Barbary ſituate?

Philo. Barbary is bounded on the N. by part of the Mediterranean, on the E. by Egypt, on the S. by Biledulgerid, and on the W. by part of the Atlantic Ocean, It extends from 29 to 37 degrees of N. latitude, and lies under the 4th and 5th N. climate. Its length is 2300, and breadth 380 miles.

Barbary is divided into 7 different parts, or kingdoms; viz. Morocco, Fez, Telenſin, Algiers, Tunis, Tripoli, and Barca, whoſe chief towns are of the ſame name.

It is chiefly under the government of the Grand Turk, and of the emperor of Morocco, who is called alſo emperor of Africa, king of Morocco, Fez, Sus, and Taffale; lord of Gago, Dara, and Guinea, and Great Zeriff of Mahomet, and, conſequently, their religion is Mahometaniſm. The longeſt day 14¼ hours, and the ſhorteſt 10½ hours, as in Egypt.

3. *Of* BILEDULGERID.

Tyro. How is Biledulgerid ſituate?

Philo. Bildulgerid is bounded on the N. by Barbary, on the E. by Egypt, on the S. by Zaara, on the W. by part of the Atlantic Ocean. It lies between 26 and 29 degrees of N. latitude, and under the 3d and 4th N. climate. Its length is about 2050, and breadth 300 miles. The length of days is from 14 hours to 10¼ hours. It is governed by many little kings, but all ſubject to the Great Turk, or to the emperor of Morocco. The whole of Africa I have laid down on a map, in order to give you a true idea of its form, diviſions, and principal places.

4. *Of* ZAARA, *or the* DESART.

Tyro. How is this Deſart ſituate?

Philo. Zaara is bounded on the N. by Biledulgerid, on the E. by Egypt and Nubia, on the S. by Negro-Land, and on the W. by the Atlantic Ocean.

It is divided into 7 parts; viz. Borno, Gago, Bardoa, Lempta, Targa, Zuenziga, and Zanhaga, whoſe capital is Targaſſa; the others have the ſame names as their provinces. It lies between 15 and 26 degrees of N. latitude, and under the 3d and 4th climate; is in length 2340 miles, and breadth about 330. The days are from 13¼ long, to 10¾ hours. Their government is by ſeveral lords and kings called Xeques, and they are chiefly Mahometans.

5. *Of* NEGRO-LAND.

Tyro. How is the land of Negroes ſituate?

Philo. Negro-Land is bounded on the N. by Zaara, on the E. by Nubia, on the S. by Guinea, on the W. by part of the Atlantic Ocean. It lies between 8 and 22 degrees of N. latitude, and under the 2d and 3d N. climate. It is computed to be about 2280 miles long, and 600 broad. It is divided into 13 provinces; viz. Genohoa, Gelata, Tombut, Agades, Cano, Caſſena, Guangara, Melli, Mandinga, Gaga, Guber, Zegzeg, and Zanfara, whoſe capitals are of the ſame name. The days are very little different in length from thoſe in Zaara. It is governed by ſeveral kings, but all, or moſt are ſubject to the king of Tombut. Groſs idolatry and Mahometiſm prevail here.

6. *Of* GUINEA.

Tyro. How is this country ſituate?

Philo. Guinea is bounded on the N. by Negro-Land, on the E. by Ethiopia Exterior, on the S. by the Ethiopian Ocean, and on the W. by the Atlantic Ocean. It is divided into 4 parts; 1. The coaſt of Maleguette, whoſe capital is Timan. 2. The Ivory Coaſt weſtward, whoſe metropolis is Toba. 3. The Golden Coaſt eaſtward, whoſe capital is St. George de Mina. And 4. The kingdom of Benin, metropolis Arda. Guinea lies between 5 and 13 degrees of N. latitude. Its length is 1320, and breadth about 400 miles. It is ſubject to the emperor of Guinea, and Paganiſm is here the prevailing ſuperſtition. Their days from 12¾ hours, to 11¾ hours.

7. *Of* NUBIA.

Tyro. How is Nubia ſituate?

Philo. Nubia is bounded on the N. by Egypt, on the E. by Ethiopia Exterior, on the S. by Ethiopia Interior, on the W. by part of Zaara and Negro-Land. It lies between 14 and 22 degrees of N. latitude, and under the ſecond and third N. climate. Its length is about 840, and breadth about 570. It is divided by the river Nubia into N. and S. The capital of North Nubia is Samna, and of South Nubia, a town, or city of the ſame name.

It is governed by its own independent prince. Their traffic is chiefly at Grand Cairo. The length of the days is much the ſame as in Zaara.

8. *Of* Ethiopia Interior.

Tyro. How is this country ſituate?

Philo. Ethiopia Interior, called alſo the land of the Abyſſinians is bounded on the N. by Nubia, and on the E. S. and part of the W. by Ethiopia Exterior. It lies under the 1ſt, 2d, and 3d N. and S. climates; and the length is computed at 3600 miles, and breadth about 2200. Ethiopia Interior is divided into 8 provinces; viz. 1. Barnagaſſo. 2. Tigremahon. 3. Dobaſſat. 4. Fatigar. 5. Angote. 6. Amara. 7. Beleguanze. And 8. Begramedri. It is governed by its own independent prince, lord, or ruler, called Naggaſi, whoſe government is deſpotic. He ſtiles himſelf the beloved of God; (ſays he ſprung from the ſtock of Judah) the ſon of the column of Sion, the ſon of the ſeed of Jacob, the ſon of the hand of Mary, the ſon of Nahu after the fleſh, and of St. Peter and Paul after the ſpirit, &c. &c. The longeſt day in the moſt northern parts of this country is aboat 13½ hours, and the ſhorteſt in the moſt ſouthern 10½ hours.

EXTERIOR.

Ethiopia Exterior is bounded on the N. by Abyſſinia, on the E. W. and S. by the Ethiopic and Indian Oceans; and, if to this you take in the land of the Hottentots, it extends to near 35 degrees S. latitude. It comprehends the kingdoms of Biafara, Loango, Congo, and Angola; the empires of Monomugi and Monopotopa; and the coaſts of the Cafres, Zanguebar, Anian, and Abex. It is governed by various princes, and the people are chiefly groſs Idolaters and Mahometans. As for the Hottentots, they ſhew no ſign of any devotion, only are very ſuperſtitious.

The days are from 12 to 14 hours.

SECT. II.

Of the AFRICAN *Iſlands.*

Tyro. WHAT are the principal iſlands in Africa?

Philo. There are many ſmall iſlands, but the moſt noted are the following; viz. 1. The iſland of Madagaſcar. 2. Cape Verde Iſlands. 3. The Canary. And, 4. the Madeira Iſlands.

1. MADAGASCAR.

This is a large iſland, lying S. E. of Ethiopia, and extends from 12 to about 22 of S. latitude; is about 1000 miles long, and 400 broad. It is called by the Portugueze St. Laurence, becauſe they firſt diſcovered it on that day. The inhabitants (except in the eaſtern part) are chiefly Pagans and Mahometans; and are ſo governed by their prieſts (called Ombiaſſes) that they are extremely ſuperſtitious. Thus, if a child be born upon ſuch a day, they ſay it is unlucky, and, therefore, give it to the wild beaſts; and, if a woman dies in childbed, they bury the living child with her, becauſe it is better ſo (they ſay) than to live without a mother to take care of it. And thus, by theſe cruel and deluſive perſuaſions, their iſland is very thin of inhabitants. It is under no particular governor.

Cape VERDE *iſlands.*

Theſe lie S. W. of Barbary, and N. W. of Guinea, between 13 and 17 degrees N. latitude, and are as follow; 1. St. Anthony. 2. St. Vincent. 3. St. Lucia. 4. St. Nicholas. 5. Inſula de Sal. 6. Bonaviſta. 7. Mago. 8. St. Jago. 9. Inſula del Fuego. 10. Bravo. The chief town is St. Domingo. They are ſubject to Portugal.

3. *The* CANARY *iſlands.*

Theſe lie N. of Cape Verde iſlands, and under 27 and 29 N. latitude. They are 7 in number; viz. 1. Lancerota. 2. Forte

Ventura. 3. Canaria, (metropolis Palma.) 4. Teneriffe, famous for its peak, which is the firſt meridian in the French maps. 5. Gomera. 6. Ferro. And 7. Palma. They are ſubject to the king of Spain.

4. MADEIRA, *or* MADEIRAS.

This lies in about 32 degrees N. latitude, and W. of Morocco. Its chief town is Funchal. It is ſubject to the Portugueze.

Tyro. Are theſe all the iſlands?

Philo. There are ſome of leſs note; viz. 1. Zocotora, ſubject to the Arabians. 2. Comoro, N. W. of Madagaſcar. 3. St. Thomas. 4. Prince's Iſland. And 5. Anaboa, ſubject to the Portugueze, lying W. of Ethiopia. 6. St. Helena, ſubject to the Engliſh, lying S. W. of St. Thomas's. And 7. The Iſle of Aſcenſion, N. W. of St. Helena. Thus much for Africa.

Tyro. I return you thanks, Sir.

Philo. Now, *Tyro,* for the laſt quarter of the world; viz. America.

DIALOGUE IV.

SECT. I.

Of AMERICA.

Tyro. WHAT is this quarter called, and how is it ſituate?

Philo. America, called the 4th or laſt quarter of the world, and weſtward on the globe.

It is divided into 2 principal parts; one called North, and the other South America. And accordingly I have drawn two maps, one of the former, and the other of the latter; which will give you adequate ideas of this extenſive quarter of the globe.

I. *Of* NORTH AMERICA.

Tyro. Why is this called North America?

Philo. Becauſe it lies on the N. ſide, or northward of the equator.

Tyro. Into how many principal parts is this divided?

Philo. Into 5, as follows; viz. 1. Mexico, or New Spain. 2. New Mexico, called Granada 3. Florida. 4. Terra Canadenſis. And 5. Terra Arctica.

1. *Of* MEXICO, *or* NEW SPAIN.

Tyro. How is this country ſituate?

Philo. Mexico, diſcovered in 1518, and conquered by the Spaniards in 1521, is bounded on the N. by Nova Granada, on the E. by the gulph of Mexico, one the W. by the Pacific Ocean, and on the S. by Terra Firma. It lies chiefly in the torrid zone, between 8 and 30 degrees of N. latitude, and is extended to about 33 degrees of longitude. The greateſt length is computed to be 2000, and breadth about 600.

Tyro. Into how many principal parts is this country divided?

Philo. Into 3, called Audiences; viz. 1. Guadalajara. 2. Mexico. And 3. Guatimala. The capitals are of the ſame names as the Audiences.

1. GUADALAJARA.

This contains the provinces of Cinaloa, New Biſcay, Zacaticas, Guadalajara, Chiamektan, and Zaliſco.

2. Mexico contains the provinces of Panuco, Mexico, Mechoachan, Los Angelos, Anlequera, Tabaſco, and Jucatan.

3. Guatimala comprehends Soco Nuſco, Guatimala, Nicaragua, Coſta Rica, Veragua, Honduras, Verapaz, and Chiapa. The longeſt day in the moſt northern part of this country is about 13½ hours, and in the moſt ſouthern about 12½ hours. It is governed by the king of Spain, under a viceroy, who reſides at Mexico. The Indians are in general Idolaters; but the Spaniards here, as in Europe, are all of the Catholic religion.

2. *Of* NEW MEXICO, *called* NOVA GRANADA.

Tyro. How is this part of North America ſituate?

Philo. This country was diſcovered by the Spaniards, 1540, and is bounded on the N. by Terra Arctica, on the E. by Florida, on the S. by Mexico, or New Syain, and on the W. by California. Its extent is not yet known. The chief town is Santa Feé, the reſidence of the Spaniſh governor.

3. *Of* FLORIDA.

Tyro. How is this country ſituate?

Philo. Florida, diſcovered alſo by the Spaniards, 1497, and poſſeſſed by them in 1527, is bounded on the N. by part of Terra Arctica, or Canada, on the E. by Britiſh America, on the S. by the Gulph of Mexico, and on the W. by New Mexico. It lies between 25 and 35 degrees of N. latitude, and under the 5th and 6th N. climate, is extended to 23 degrees in longitude, and computed to be about 1000 miles long, and 600 broad, in its greateſt length and breadth.

The natives are groſs idolaters, and the main part is governed by ſeveral diſtinct lords, or rulers: but the places upon, or near the ſea coaſts, are now ſubject to the Engliſh. The longeſt day in the moſt northern part is about 14¼ hours, and the ſhorteſt in the moſt ſouthern about 10½ hours.

Its chief towns are St. Auguſtine and Penſacola.

4. *Of* TERRA CANADENSIS.

Tyro. How is this country ſituate?

Philo. It is bounded on the N. by part of Terra Arctica, on the E. by the Atlantic Ocean, on the S. by the Gulph of Mexico, and on the W. by New Mexico and parts unknown. It lies between 30 and 62 degrees of N. latitude, and extends to near 40 degrees of longitude: is about 2100 miles in length, and 1600 in breadth.

Tyro. But pray, is it not divided into ſome principal parts?

Philo. Yes, into N. and S. The N. comprehends, 1. Terra Canadenſis Propria. 2. Nova Britannia, or New Britain. 3. Nova Francia, New France, or Canada; chief town Quebec. This laſt was ceded to Great Britain by the late treaty of peace.

Tyro. What does the S. part contain?

Philo. 1. Nova Scotia. 2. New England. 3. New York. 4. The Jerſeys. 5. Penſilvania. 6. Maryland. 7. Virginia. And 8. Carolina: all ſubject to the crown of Great Britain.

The metropolis of theſe towns in order are, 1. Hallifax in Nova Scotia. 2. Boſton. 3. New York. 4. Elizabeth. 5. Philadelphia. 6. Annapolis Royal. 7. James Town. And 8. Charles Town.

N. B. Theſe lie one after another in order from N. to S.

1. Nova Scotia, diſcovered 1622.

2. New England, in 1497, and poſſeſſed for queen Elizabeth, by Sir Philip Amadas, 1558.

3. New York, by Mr. Hudſon, 1608, and ſold to the Dutch, who kept it till 1664;

1664; at laſt it was given by Charles II. to the duke of York; it was called before New Netherland.

4. New Jerſey, was diſcovered in 1497.

5. Penſilvania, about the ſame time, was given by Charles II. to William Penn, Eſq. by letters patent in 1680.

6. Virginia, in 1427, but more particularly in 1584, by Sir Walter Raleigh, who is ſaid to be the firſt that brought tobacco into England. It was called Virginia, in honour to queen Elizabeth, as a virgin queen.

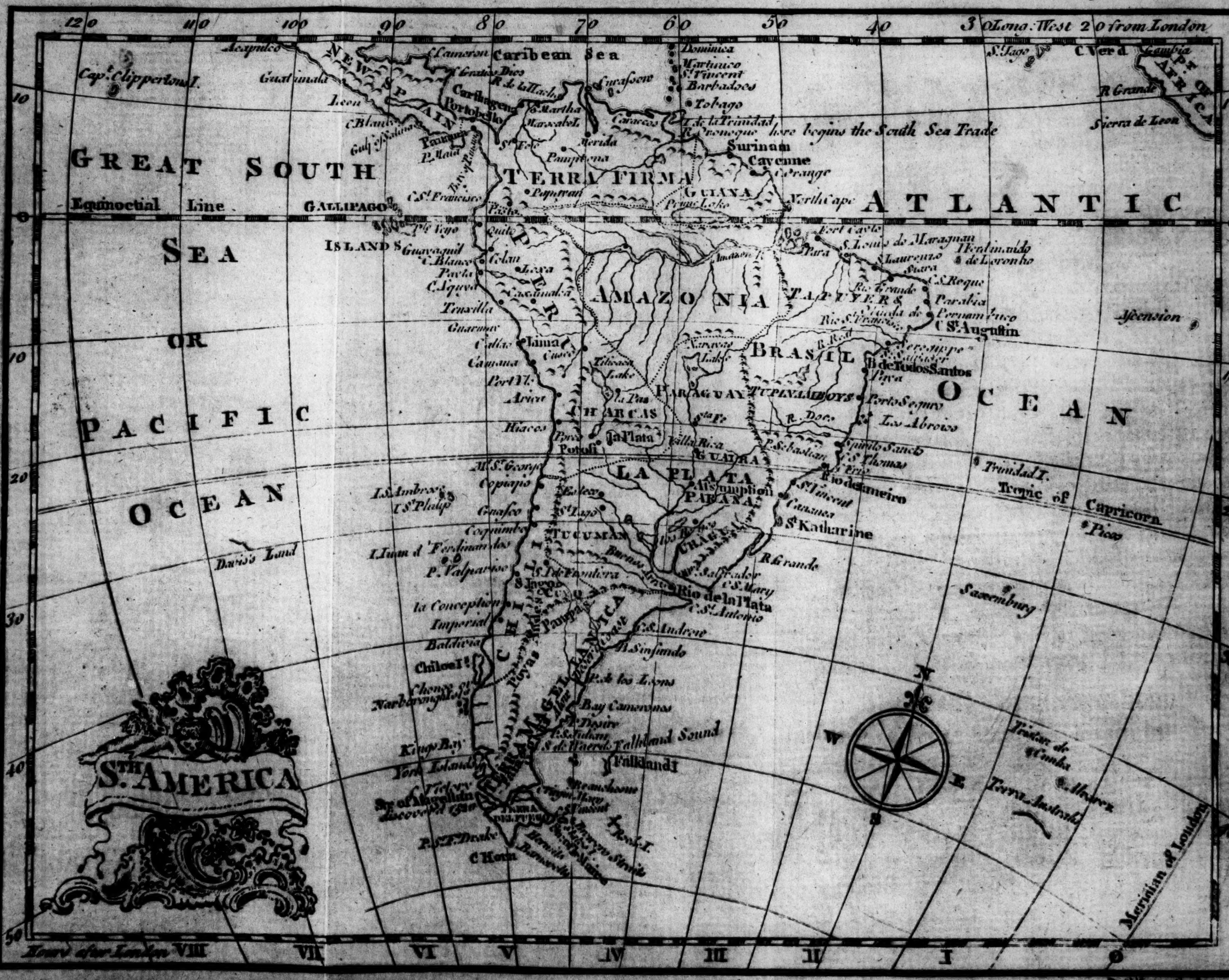
7. Maryland, was alſo diſcovered by the Engliſh under the two Cabots, 1497, and is bounded on the S. by Virginia. It has its name from Mary, wife of Charles I. who gave it by letters patent under that name to the right honourable Cæcilius Calvert, lord Baltimore, 1632.

8. Carolina, diſcovered about the ſame time with Virginia, and in 1660 granted by patent to ſeveral noblemen, by Charles II.

5. Of TERRA ARCTICA.

Tyro. What do you mean by Terra Arctica?

Philo. This country is called Arctica, becauſe it lies towards the North; it comprehends thoſe parts of America ſituate near, or towards, the N. pole, or polar circles.



J. Gibson Sculp.

Tyro. Which are they?

Philo. There are many of them; but the chief and moſt noted are, 1. Greenland. 2. Spitſberg. 3. Nova Zembla. 4. Terra de Jeſſo. 5. New Denmark. And 6. New North Wales.

Little more is known of theſe at preſent but their names, and therefore they cannot be taken any further notice of.

II. *Of* SOUTH AMERICA.

Tyro. Why is this ſo called?

Philo. Becauſe it lies chiefly on the S. ſide of the equator.

Tyro. Into how many principal parts is it divided?

Philo. Into 8; viz. 1. Terra Firma. 2. Peru. 3. The Land of the Amazons. 4. Braſil. 5. Chili. 6. Paraguay. 7. Terra Magellanica. And 8. Terra Antarctica.

1. *Of* TERRA FIRMA.

Tyro. How is this ſituate?

Philo. Terra Firma, diſcovered in 1514, lies under the 1ſt N. climate, and is bounded on the N. by the Atlantic Ocean, on the E. by the ſame, on the S. by Peru and the country of the Amazons, and on the W. by the Pacific Ocean. It is extended to about 27½ degrees longitude, and lies between 1 and 11½ degrees of N. latitude. It is computed to be about 1500 miles long, and 750 miles broad.

Tyro. How is it divided?

Philo. Into E. and W. The E. upon the river Oroonoque, called 1. Guiana, whoſe chief town is Manhoa. And 2. Caribeana, whoſe metropolis is Moreſhego. The W. comprehends the provinces of

1. Panama, called alſo Terra Firma; chief town is Panama.
2. Carthagena, metropolis the ſame.
3. St. Martha, metropolis the ſame.
4. Rio de la Hacha, metropolis the ſame.
5. Andaluzia, metropolis St. Thomas.
6. Comana, metropolis Comana.
7. New Granada, metropolis St. Feé de Bagota.
8. Papayan, metropolis Papayan.

It is governed, for the king of Spain, by a viceroy reſiding at Mexico. The natives of this country, eſpecially in the middle, are groſs idolaters.

2. Of PERU.

Tyro. How is this country ſituate?

Philo. Peru, firſt diſcovered by the Spaniards, 1525, is bounded on the N. by part of Terra Firma, on the E. by Amazonia, on the S. by Chili, and on the W. by the Pacific Ocean. It lies between 24 degrees of S. and 1 degree of N. latitude, and is extended to 20 degrees of longitude, and under the 1ſt, 2d, and 3d S. climate.

Tyro. How is it divided?

Philo. Into 6 provinces.

1. Poſto, whoſe metropolis is Poſton.
2. Los Quixos, whoſe metropolis is Baeſa.
3. Pacamores, whoſe metropolis is Valladolid.
4. Quito, metropolis Quito.
5. Lima, metropolis Lima.
6. Los Charcos, metropolis Potoſi.

The natives in general are very groſs idolaters, worſhipping the ſun, moon, ſtars, thunder, lightning, &c. But in ſome parts there are Chriſtians, &c.

It was conquered by the Spaniards in 1533, and they have the moſt conſiderable part of it under their dominion.

3. *Of the Land of the* AMAZONS.

Tyro. How is this land ſituate?

Philo. This country, diſcovered by the Spaniards in 1541, is bounded on the N. by Terra Firma, on the E. by Braſil, on the S. by Paraguay, and on the W. by Peru.

It lies under the 1ſt, 2d, and 3d. S. climate. It is under no particular government, the inhabitants in general being a ſavage ſort of people, appearing always in arms. It is ſuppoſed to take its name from thoſe warlike women called (by ſeveral poets and hiſtorians) Amazons, of whom it is reported that they cut off one of their breaſts, not only for the better qualifying themſelves to hold their bows, and ſhoot the ſurer, but that they might be the more ſavage and ferocious.

4. *Of* BRASIL.

Tyro. How is Braſil ſitnate?

Philo. This country, diſcovered by the Portugueze, about 1501, is bounded on the N. by Terra Firma, on the E. by the Atlantic Ocean, on the S. by Paraguay and part of the ſame Ocean, and on the W. by the land of the Amazons.

It lies between one and 23 degrees of S. latitude, and under the 1ſt, 2d, 3d, and 4th S. climate.

Its greateſt length is computed to be about 2500 miles, and its breadth about 700.

Tyro. Into how many principal parts is it divided?

Philo. There is not any particular account of its provinces, diviſions, &c. but the chief towns that are known, or moſt worthy of note, are as follow: 1. St. Vincent. 2. Sanctos. 3. Angra Dos Reyes. 4. St. Sebaſtian. 5. Spiritu Sancto. 6. Porto Seguro. 7. St. Salvadore. 8. Pernambuco. And 9. Parayba.

The natives are under no particular government, nor profeſs any religion, being chiefly ſunk into groſs ignorance, idolatry, &c.

5. *Of* CHILI.

Tyro. How is this country ſituate?

Philo. Chili, diſcovered by the Spaniards about 1554, is bounded on the N. by Peru, on the E. by Paraguay, on the S. by Terra Magellanica, and on the W. by the Pacific Ocean.

It lies between 25 and 44 degrees of S. latitude, and under the 4th, 5th, and 6th S. climate.

Its length is computed to be about 1100 miles, its breadth 600.

Tyro. Into how many parts is Chili principally divided?

Philo. Into 3; viz. 1. Chili Proper. 2. Chili Imperial. And 3. Chucuito, whoſe chief towns are St. Jago, Baldivia, and St. John de Fontiera.

It is chiefly governed by the viceroy of Peru, under the king of Spain.

6. *Of* PARAGUAY.

Tyro. How is Paraguay ſituate?

Philo. This country, diſcovered alſo by the Spaniards in 1546, is bounded on the N. by the land of the Amazons, on the E. by the Atlantic Ocean, on the S. by Terra Magellanica, and the W. by Chili and Peru.

Tyro. Whence has it its name?

Philo. From the river Paraguay; but it is called by the Spaniards (and currently by others) Rio de la Plata.

It lies between 18 and 37 degrees of S. latitude, and under the 2d, 3d, 4th, and 5th S. climate, and extends to about 32 degrees of longitude.

Its length is computed about 1200 miles, and breadth about 1100 miles.

Tyro. Into how many principal parts is it divided?

Philo. The moſt material-provinces are 5 in number; viz. 1. Guayra, whoſe chief town is Cividad Real. 2. Paragua Propria, whoſe chief town is Aſſumption. 3. Chaco, whoſe chief town is Conception. 4. Tucoman, whoſe chief town is St. Jago. And 5. Rio de la Plata, whoſe chief town is Buenos Ayres. It is governed chiefly by a viceroy.

7. *Of* TERRA MAGELLANICA.

Tyro. How is this country ſituate?

Philo. It is bounded on the N. by part of Paraguay and Chili, on the E. by the Atlantic Ocean, on the S. by Terra Antarctica, and on the W. by the Pacific Ocean.

It was diſcovered about 1519, by one Ferdinand Magellan, from whom it took its name.

8. *Of* TERRA ANTARCTICA.

Tyro. How is this country ſituate, and why ſo called?

Philo. Terra Antarctica ſignifies thoſe countries that lie between the Antarctic circle and the S. pole; the chief of which are New Zealand, New Guinea, New Holland, and Terra Auſtralis Incognita. And now, Tyro, we proceed to

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SECT II.

Of the AMERICAN *Iſlands.*

Tyro. WHAT are the principal iſlands of America?

Philo. They are 11, which are thus divided:

1. To the N. are		1. California. 2. Newfoundland.
2. Middle the Antilles.	Greater	3 Cuba. 4. Jamaica. 5. Hiſpaniola. 6. Porto Rico.
3. To the S. are	Leſſer	7. Caribees. 8. Lucayes. 9. Sotovento. 10. Bermudas. 11. The Iſland of Terra del Fuego.

1. *Of* CALIFORNIA.

The northern part of this peninſula, was diſcovered by Sir Francis Drake in 1577. It has Mexico on the E. and the Pacific Ocean on the W. It lies in 35 degrees N. latitude.

2. *Of* NEWFOUNDLAND.

This iſland was diſcovered by the two Cabots, in the time of Henry VII. 1497; but more perfectly by Thorn and Elcot of Briſtol, in 1527. It lies between 47 and 51 degrees of N. latitude, near New Britain.

Avalon is its chief province, which was built upon by Sir George Calvert in 1623, by a patent granted to him, and afterwards enjoyed by Cæcilius lord Baltimore. It is ſubject to the crown of England.

3. *Of* CUBA.

This iſland was diſcovered by the Spaniards in 1594. It lies N. of Jamaica, N. W. of Hiſpaniola, and S. of the Bahama iſlands. It lies between 19 and 23 degrees N. latitude, and extends to about 8 degrees of longitude. It is ſubject to the king of Spain, and the chief towns are the Havanna and St. Jago.

4. *Of* JAMAICA.

This was diſcovered by Columbus, and conquered from the Spaniards by Penn and Venables in Oliver Cromwell's time. It was firſt called St. Jago, but afterwards Jamaica, in honour of James duke of York.

It lies S. of Cuba, and W. of Hiſpaniola, and between 18 and 19¼ N. latitude, and extends to about 3 degrees of longitude.

It is ſubject to the Engliſh. Its chief town is Port Royal.

5. *Of* HISPANIOLA.

This was diſcovered alſo by Columbus in 1492. It lies between 17 and 20 degrees of N. latitude. It has Cuba on the N. W. Jamaica on the W. and Porto Rico on the E. It is ſubject to France; and its principal town is St. Domingo.

6. *Of* PORTO RICO.

Porto Rico (once called Johannis Inſula, and by the natives Bonquin) lies E. of Jamaica, about 18 N. latitude. It is called Porto Rico from the city and haven of the ſame name.

7. *Of the* CARIBEE *Iſlands.*

Tyro. Why are theſe iſlands ſo called?

Philo. From the inhabitants, who upon the firſt diſcovery were found to be Cannibals.

bals. They repreſent the ſegment of a circle, are about 30 in number, and extend from about 17 degrees N. almoſt to Terra Firma.

The chief among them are, 1. Anguila. 2. St. Martin. 3. Sancta Crux. 4. Barbuda. 5. St. Chriſtopher's. 6. Nevis, or Mevis. 7. Antego. 8. Montſerat. 9. Guadalupe. 10. Marigalant. 11. Dominica. 12 Martinico. 13. Barbadoes. 14. St. Lucia. 15. St. Vincent. 16. Granada. And 17. Tobago.

Note. Some of theſe belong to the Engliſh, ſome to the French, and others to the Dutch. One of the moſt conſiderable of them is Barbadoes, about $13\frac{1}{2}$ degrees N. latitude. It is ſubject to the Engliſh.

8. *Of the* LUCAYES.

Tyro. Why are theſe ſo called?

Philo. From Lucayos, the longeſt of them all. They extend from the coaſt of Florida, to the N. of Hiſpaniola.

The chief of them are, 1. Bahama. 2. Lucayos. 3. Cignatio. 4. Guanahani. 5. Tuma. 6. Tama. 7. Samana. And 8. Maiaguana.

The principal of theſe is Bahama, near Cape Florida, and remarkable for ſpiders, they being about 2 inches long, and having, in general, 6 eyes.

9. *Of the* SOTOVENTO.

Theſe are ſo called by the Spaniards to whom they chiefly belong, and are found from E. to W. along the coaſt of Terra Firma. The principal of them are, 1. Trinidada. 2. Margarita. 3. Tortuga. 4. Orchilla. 5. Rocca. 6. Bonayre. 7. Curacoa. And 8. Aruba.

10. BERMUDAS.

Bermudas, ſo called from John Bermudas, a Spaniard, who firſt diſcovered it. It lies between 32 and 33 degrees of N. latitude, about 240 Engliſh leagues E. of Carolina; and is ſubject to the crown of Great Britain.

11. *Of* TERRA DEL FUEGO.

This (according to ſeveral hiſtorians) is ſo called, on account of ſeveral volcanos. It is ſituate S. of Magellanica, and parted from the continent by the Streights of Magellan, lying between 52 and 53 degrees S. latitude.

And thus, *Tyro*, I have given you as complete a view of Geography as I could in ſo narrow a compaſs; and I hope it will be ſufficient to ſatisfy the curioſity of young beginners, and qualify them in time for underſtanding thoſe authors that have treated more largely and particularly on the ſubject.

And now, *Tyro*, we are come to that part in which I propoſed to teach you the uſe of the globes, called by ſome practical, by others experimental geography.

DIALOGUE V.

Between PHILO, *a Tutor, and* TYRO, *his Pupil, concerning the nature, properties, and uſe of the* GLOBES.

SECT. I.

Tyro. WHAT is the globe, or ſphere?

Philo. A globe, or ſphere, is a ſolid round body, contained under one ſurface; having a point in the middle, called the center, from whence all lines draw to the ſurface are equal.

Tyro. Pray, how is a globe generated or formed?

Philo. It is made by the rotation of a circle, or ſemi-circle, broad ways upon its axis: thus, a ſhilling preſſed upon its edge, by two pins oppoſite each other, and blown round, will naturally repreſent the formation, or ſhape of a globe.

Tyro. How many ſorts are there?

Philo. Two, one called the Terreſtrial, or earthly; the other the Celeſtial, or heavenly globe.

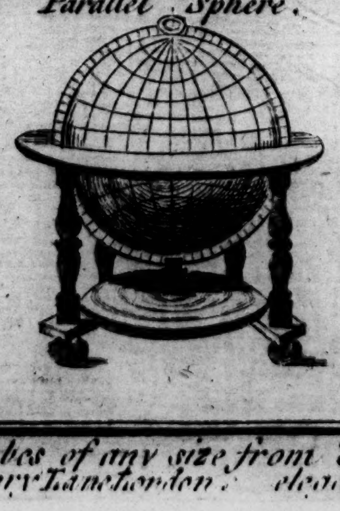
Tyro. What does the Terreſtrial globe teach us?

E'er half the SCHOOL *Authors be Read it will be seasonable for* YOUTH *to learn the Use of the* GLOBES.

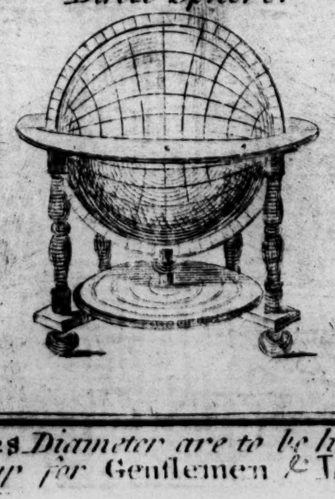
MILTON *on* Education.

The **GLOBE** *or Sphere in its Three Different* **Positions**.

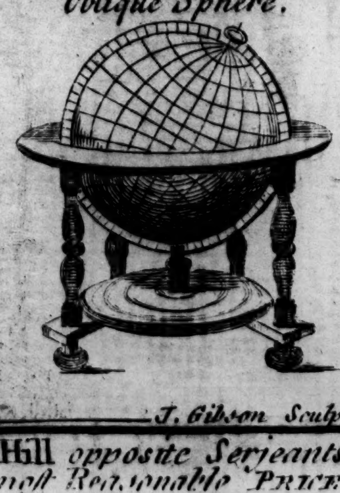
Parallel Sphere.



Direct Sphere.



Oblique Sphere.



J. Gibson Sculp.

Globes of any size from 3. *to* 28. **Inches** *Diameter are to be had of* Mr. N Hill *opposite Serjeants Inn Chancery Lane London: elegantly fited up for* Gentlemen & Ladies *at the moſt Reaſonable* PRICE.

Philo. By the Terreſtrial Globe we are taught the knowledge of the earth and ſea; with the ſituation of places, their difference in latitude and longitude; the ſun's riſing and ſetting; the length of days and nights throughout the year, and the true diſtance from one place to another. This is called Geography.

Tyro. What is the uſe of the Celeſtial Globe?

Philo. The Celeſtial Globe, not only teaches us the ſun's riſing and ſetting, but alſo the riſing and ſetting of the ſtars, together with their right Aſcenſion, Declination, Amplitude, Almacanther, Azimuth, Latitude, Longitude, and Diſtance from each other. This is called Aſtronomy.

Tyro. But I muſt know firſt what Almacanther, Azimuth, &c. mean.

Philo. That you ſhall know by and by: but firſt you muſt learn the names of the appendants and different circles belonging to the Globe.

Tyro. Pleaſe then to let me know what they are.

Philo. I will, and only take a little pains to learn the nature of them, and you will ſoon be qualified to work ſome problems yourſelf.

SECT II.

A further deſcription of the Globes, *with the great circles and appendants belonging to them.*

Tyro. WHAT do you mean by great circles of the ſphere?

Philo. Great circles are ſuch as cut the globe into two equal parts, paſſing through the center: all ſuch as do not cut the ſphere in two equal parts, are called leſſer circles.

Tyro. Pray, how many great circles are there?

Philo. 1. The Equator, or Equinoctial. 2. The Ecliptic, or Zodiac. 3. The Brazen Meridian. 4. The Horizon. And 5. The Colures.

1. *Of the* EQUATOR.

Tyro. What is the Equator, or Equinoctial?

Philo. The Equator on the Terreſtrial, or Equinoctial on the Celeſtial Globe, is a line, or circle, that cuts the Globe in two equal parts, called northern and ſouthern hemiſpheres, whoſe poles are thoſe of the world, dividing the N. from the S. and upon the Globe is eaſily known by two broad lines running parallel to each other, and a fine hair line between them: it is divided into 360 equal parts, called degrees, beginning at the firſt meridian (or ſign Aries)

Aries) and is marked from 1 with 10, 20, 30, 40, &c. to 360, quite round.

Tyro. But there are other figures on the lower edge, or part of the Equator on the Terreſtrial Globe; are there not?

Philo. Not on all Globes. Senex's globes, indeed (which, as I ſaid before, I would recommend) are alſo marked from the meridian of London, with 10, 20, 30, &c. to 180 degrees to the right-hand, or E. and backwards from London, with 10, 20, 30, &c. to 180, W.

Tyro. And, pray, what is the uſe of this?

Philo. The Equator ſhews you the longitude of any place, either E. or W. from the firſt meridian; and this lower line on Senex's globe ſhews you the longitude of any place from London, which is extremely convenient. The Equinoctial ſhews the right and oblique aſcenſion of the ſun, or any ſtar.

2. *Of the* ECLIPTIC *and* ZODIAC.

Tyro. What, or which is the Ecliptic?

Philo. The Ecliptic is another great circle of the ſphere, whoſe poles are in the polar circle, where it is interſected by the *ſolſtitial Colure*, running from Cancer South, and from Capricorn Northward. It cuts the Equator at the two points Aries and Libra, making an angle at each point of 23 degrees, 30 minutes, which is its furtheſt, or utmoſt extent, either N. or S. from the Equator, as you will ſee more plainly hereafter.

Tyro. What is the Zodiac?

Philo. The Zodiac is a broad imaginary circle, which extends itſelf (according to the rules of Aſtronomy) eight degrees on each ſide of the Ecliptic, and is that which contains the 12 ſigns, and in which the planets perform their revolutions. The line in the middle of the Zodiac, is called the Ecliptic; becauſe Eclipſes happen in or near that line. It is called Via Solis, the Sun's path, way, or motion. ☞ Though in Aſtronomy, it is that circle, or path, that the earth deſcribes to an eye, placed in the center of the ſyſtem, viz. the ſun.

Tyro. Pray, Sir, tell me in what manner the Ecliptic is divided, for, I think, I have ſome notion of it.

Philo. The Ecliptic (like the Equator) is divided into 360 degrees, but not numbered from 1, 10, &c. as the Equator is, but is divided into 12 equal parts, containing 30 degrees each, which are called Signs, and have different names and characters.

Tyro. Pleaſe to let me know them.

Philo. I will; and you muſt mind to get the names of them by heart, and the character belonging to each, ſo as to know them at firſt ſight.

The SIGNS.

NORTHERN SIGNS.

Aries.	*Taurus.*	*Gemini.*	*Cancer.*	*Leo.*	*Virgo.*
♈	♉	♊	♋	♌	♍

SOUTHERN.

Libra.	*Scorpio.*	*Sagittarius.*	*Capricornus.*	*Aquarus.*	*Piſces.*
♎	♏	♐	♑	♒	♓

☞ Take notice, the firſt ſix are called the Northern, the other the Southern Signs; and you are to mind which are oppoſite to each other (for that is very material) as ♈ is oppoſite to ♎, ♐ to ♊, &c. for it will ſhew you the different times and ſeaſons of the year, &c. very readily, when you come to perform any operation.

Tyro. I will obſerve what you ſay, but pleaſe to tell me the ſignification of their names.

Philo. It is of no great ſervice; however, here they follow: Aries ♈, or the Ram; Taurus ♉ the Bull; Gemini ♊ the Twins; Cancer ♋ the Crab; Leo ♌ the Lion; Virgo ♍ the Virgin; Libra ♎ the Balance; Scorpio ♏ the Scorpion; Sagittarius ♐ the Archer; Capricornus ♑ the Goat; Aquarius ♒ the Water-bearer; and Piſces ♓ the Fiſhes.

Tyro. Pray, Sir, inform me why the ancient aſtronomers affixed ſuch images as the

Ram, the Bull, &c. to the 12 ſigns of the Zodiac.

Philo. It is not eaſy to give a poſitive anſwer to your queſtion; but there is great reaſon to ſuppoſe that they were placed as Hieroglyphics of the ſeaſons of the year, alluding to the annual courſe of the Sun.

Thus Aries, Taurus, and Gemini, repreſent March, April, and May, the ſpring quarter of the year, when Lambs, Calves, and Goats (the latter generally bringing forth twin Kids) are produced.

Cancer, the Crab, which creeps both ways, repreſents the increaſe and decreaſe of the Sun's declination, to and from the ſummer ſolſtice, in June.

Leo, the Lion, intimates the raging heat of the ſun in July, which the ancients compared to the furious nature of that fierce animal.

Virgo, the Virgin, with a ſpike or ear of corn in her hand, properly repreſents Auguſt, when the harveſt of the earth is ripe.

Libra, the Balance, is diſplayed in September, to intimate that the days and nights, at the autumnal Equinox, are equal in all parts of the globe.

Scorpio, the Scorpion, a noxious animal is placed as the Hierogliphic of October; becauſe, at that ſeaſon, diſeaſes of various kinds too often rage.

Sagittarius, the Archer, marks November, as the proper time for hunting.

Capricornus, the Goat, by its climbing up the rocks, is placed as an emblem of December, when the ſun, at the winter ſolſtice, begins to aſcend again towards the Equinoctial.

Aquarius, the Water-bearer, with his urn, repreſents January, when rains are frequent.

Piſces, the Fiſhes, are emblems of the fiſhing ſeaſon, which began in the Nile during the month of February.

N. B. The Ecliptic cuts, or interſects the Equator, or Equinoctial, at the two points, or ſigns, Aries ♈ and Libra ♎, viz. on the 21ſt of March, and the 22d of September, N. S. on which days the ſun is in the Equator, and has no declination, either N. or S. and the days and nights are then equal to all the inhabitants on the globe, as you will plainly ſee by and by.

3. *Of the* BRAZEN MERIDIAN.

Tyro. What is the Brazen Meridian?

Philo. The Brazen Meridian is another great circle, which divides the Globe into two equal parts, called the Eaſtern and Weſtern hemiſpheres, whoſe poles are in the Eaſt and Weſt points of the Horizon. It is repreſented by a thick braſs hoop, which ſurrounds the Globe, from N. to S.

and divides the Equator into 2 equal parts, viz. the E. and the W. and is that on which the Globe itſelf is hung, or turns round upon its axis, the extremities of which are called the poles.

Tyro. How is the Brazen Meridian marked, or divided?

Philo. Like the Equator and Ecliptic, into 360 degrees; but with this difference, it is divided into 4 nineties.

Tyro. In what manner, pray?

Philo. From the Equator towards the N. and S. pole, the Meridian is marked with a cypher over the Equator thus (0) and on each ſide, with 10, 20, 30, 40, 50, 60, 70, 80, and 90, which ends in each pole. Then again, from each pole to the Equator on the other half of the Meridian, is marked 10, 20, 30, 40, &c. to 90, which ends in the Equator.

Tyro. Then I plainly perceive by this, that as many degrees as one pole is elevated or raiſed, ſo many degrees will the contrary pole be depreſſed.

Philo. Your notion is very juſt.

Tyro. But pray, what is the principal uſe of this circle?

Philo. The Brazen Meridian ſhews you the latitude of places, and their difference of latitude, either N. or S. from the Equator: for the latitude of a place is the ſame as the elevation of the pole above the Horizon.

That is, whatever figure, or number, the Horizon cuts the Meridian in, ſo many degrees is the pole elevated, which is the latitude, as you will more plainly ſee, when we come to ſpeak of latitude and longitude.

4. *Of the* HORIZON.

Tyro. What is the Horizon?

Philo. The Horizon is that great circle which divides the heavens and earth into two equal parts, one called the upper, and the other the lower Hemiſphere, whoſe poles are in the Zenith and Nadir. There are two ſorts, the one called the ſenſible or natural, the other the rational or mathematical Horizon.

Tyro. What is the ſenſible Horizon?

Philo. The ſenſible Horizon is that which divides the viſible part of the heavens from the inviſible; and is that great circle which we ſee all round us (ſtanding upon any hill, or at ſea) juſt in the points where the heavens and earth ſeem to meet, or to be joined together.

Tyro. What is the rational Horizon?

Philo. The rational, or real Horizon, is that which paſſes through the center of the earth, and divides it (as was ſaid before) into the upper and lower Hemiſphere.

☞ This rational Horizon is repreſented by that broad wooden circle, lying with its face upwards, having two notches cut in it, one in the N. and the other in the S. part, in which the Brazen Meridian is ſlipt, or moved up or down, at pleaſure: the poles of the Horizon are the Zenith and Nadir.

Tyro. Pleaſe to give me a further deſcription of the Horizon.

Philo. There are 4 circles on the face of the wooden Horizon; viz.

1. The inner circle, or that circle at the inward edge next the globe, is divided into 12 equal parts, or ſigns, anſwering to the 12 ſigns in the Ecliptic, with their names likewiſe prefixed to them. Thus, the ſign ♈, is wrote Aries; the ſign ♉, is wrote Taurus; and ſo of the reſt. *Note.* Aries ♈ is in the E. Libra ♎ in the W. Cancer ♋ in the N. and Capricornus ♑ in the S. point of the Horizon.

2. Next to theſe ſigns is a calendar of months, according to the Julian account, or Old Stile (uſed in England till the year 1752;) ſo that the inward circle being divided into degrees, anſwers the days of the month, for right againſt the day is the degree of each ſign which the ſun enters on any day: and, *vice verſa*, right againſt the ſign, or degree, is the day of the month anſwering thereto.

3. Next to this is another calendar according to the Gregorian account (formed by pope Gregory XIII. in the year 1582) called the New Stile, which is 11 days ſooner than the Old Stile, as you may ſee by the poſition of the Calendars, the 10th of

March in the firſt, or Old Calendar, being right againſt the 21ſt in the New, or Gregorian Calendar. This New Stile is now uſed by us in England, as well as in foreign nations, purſuant to an act of parliament in 1751 *.

Laſtly. On the outward verge of the Horizon is the circle of the winds, or rhumbs, viz. the Mariner's compaſs, being 32 in number (beginning at the N.) Each point, or rhumb, contains 11¼ degrees; for 32 multiplied by 11¼ makes 360. But if you have Senex's Globes, improved by Mr. Martin, the Horizon has on it 5 circles.

1. The circle next the Globe ſhews the Azimuths from South to North, both Eaſtward and Weſtward 180 degrees.

2. The next circle is that of Amplitudes, numbered from the Eaſt and Weſt points, to both North and South, 90 degrees.

3. The third circle contains the 32 points of the Mariner's compaſs.

4. The fourth is that of the Months and Days throughout the Year.

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* ☞ *Note.* Though this deſcription of the Horizon anſwers moſt globes, yet you are to obſerve, that on Senex's globes (and I ſuppoſe others) made ſince the alteration of the ſtile, 1752, the New Stile is put upon the inner circle next the ſigns on the Horizon, and the Old Stile is outward. But this can create no difficulty; for it is very eaſy to ſee which is the New, and which is the Old Calendar on any globes; the New being 11 days before the Old, ſo that one being known, the other will eaſily be known alſo.

5. The fifth circle is the Ecliptic, and contains the names, marks, and figures of the 12 Signs of the Zodiac.

Tyro. Sir, I thank you kindly. Pray, tell me now the uſe of the Horizon.

Philo. The Horizon ſhews the riſing and ſetting of the ſun, length of days and nights; alſo the riſing and ſetting of the ſtars in any latitude; together with the Azimuth, Amplitude, Almacanther, &c. of the ſun, or any ſtar, and the point they riſe or ſet upon, &c.

5. *Of the* COLURES.

Tyro. Pray, what are the Colures?

Philo. The Colures are two great circles, cutting the Equator at right angles, and paſſing through the poles of the world.

The Solſtitial Colure is that great circle which paſſes through Cancer and Capricorn, ſhewing Winter and Summer.

The Equinoctial Colure paſſes through Aries and Libra, and ſhews the Spring and Autumn.

And, now, having given you a full deſcription of the principal circles; I propoſe to deſcribe the leſſer, and ſhew you more of the nature of the globe, and the appendants belonging to that inſtrument.

DIALOGUE VI.

Concerning the leſſer *circles of the* Sphere, *commonly called* parallel *circles.*

SECT. I.

Tyro. WHAT do you mean by the leſſer, or parallel circles?

Philo. All ſuch circles as do not divide, or cut the globe into two equal parts, but that cut off any ſegment, or part, leſs than the half, are leſſer circles.

Tyro. Why are they called parallel circles?

Philo. Becauſe they are parallel every where to the Equator *.

Tyro. Pray, tell me the names of the leſſer circles.

Philo. They are the Tropics and Polar circles.

1. *Of the* TROPICS.

Tyro. Pray, which are the Tropic Circles?

Philo. Look for the ſign Cancer on the globe, and you will find a circle drawn with a double line from thence round the globe, parallel to the Equator, which is called the Northern Tropic, or Tropic of Cancer, being 23½ degrees from the Equator northward, ſhewing the ſun's greateſt northern declination. Then looking for the ſign Capricorn, you will find the ſame ſort of circle, which is called the *Southern Tropic*, being alſo 23½ degrees from the Equator, and ſhews the ſun's greateſt ſouthern declination, or departure from the Equinoctial.

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* In the Latitude or Parallel of London, a degree contains about 37 miles on the Equator.

2. *Of the* POLAR CIRCLES.

Tyro. Which are the Polar Circles?

Philo. They are two ſmall circles, lying near the poles (viz. 23½ degrees diſtant from them) drawn alſo with double lines: that on the N. is called the Arctic circle, and that on the S. the Antarctic circle. They are called Polar Circles, from their being deſcribed by the revolution of the Poles of the Ecliptic, round the poles of the world, at 23 degrees, 30 minutes, diſtance from them, by a retrograde motion, in 25920 years; occaſioned by the preceſſion of the Equinoxes, 50 ſeconds every year.

Tyro. Pray, what is their uſe, or what do we learn from them?

Philo. All thoſe inhabitants that live under theſe lines have their longeſt day juſt 24 hours long, and their longeſt night the ſame (ſave the benefit of twilight, which is but trifling.) If you go further towards the poles, their days are 2, 3, and 4 days, or 2, 3, 4, or 6 months long, as you will find demonſtrated in the problems.

Tyro. Surpriſing! I long to ſee thoſe places, having heard of ſuch things, but always looked upon them as idle tales.

Philo. You may depend upon the truth of it, and will ſoon ſee the reaſon. But, now, we will ſhew you the Appendants belonging to the globes.

SECT. II.

Of the Appendants *belonging to the* Globes.

Tyro. WHAT do you mean by Appendants?

Philo. Appendants are in ſome reſpects the ſame as Appurtenances, being ſuch neceſſary things, both moveable and immoveable, as belong to globes; the principal or chief of which are as follow.

1. *Of the* Hour Circle, *and* Index.

Tyro. Pray, what is the Hour Circle, and its uſe?

Philo. The Hour Circle, called alſo the Horary Circle, or Dial Plate, is a ſmall circle of braſs, divided into 24 hours; the upper 12 repreſents noon, and the lower 12 midnight. It is ſkrewed on the meridian round the N. pole, and on the pole itſelf is placed the Index, or Hand, which turns round with the globe.

Its uſe is to tell the time of the riſing and ſetting of the ſun, or ſtars, in any latitude; and what o'clock it is in any part of the world, &c.

2. *Of the* Quadrant *of* Altitude.

Tyro. Pray, what is the Quadrant of Altitude?

Philo. This is a thin piece of pliable braſs, divided into 90 degrees, anſwering to the degrees of the Equator, beginning at the lower end with (0) and proceeding to 10, 20, 30, &c. till we come to 90. At which figure it has a nut, which ſlips upon the meridian at pleaſure, and is faſtened thereto by a ſkrew.

Tyro. Pray, what is the chief uſe of this Appendant?

Philo. Its uſe is to tell the height of the ſun, or ſtars, at any hour, and when they are due E. or W. Alſo the diſtance of the ſtars from one another, and the diſtance of one place from another on the terreſtrial globe, &c. &c. &c.

3. *Of the* Semi circle.

Tyro. What is the Semi-circle of poſition?

Philo. It is a thin piece of braſs, divided into 180 degrees, anſwering to one half of the Equator. It may be called a double quadrant of Altitude, but is uſed only in ſome particular problems, the Quadrant, or Horizon, in general, ſupplying its place.

4. *Of the* Nautical Box, *or* Mariner's Compaſs.

Tyro. What is the Nautical Box, and its uſe?

Philo. This is an inſtrument uſed in navigation, having the 32 points of the wind marked, or drawn, on a Card, and a needle being touched with the load-ſtone points always northward. This Card, or Chart, is hung in an Horizontal Plane, and fixed on any part of the Horizon of the globe, or elſewhere, to ſhew what point of the compaſs you are ſailing upon, or how any object bears from you.

SECT. III.

Concerning the different names of the Sphere, *according to its different poſition, or ſituation.*

Tyro. WHAT do you mean by the Sphere's having different names according to its poſition? I do not underſtand you.

Philo. Obſerve then. There are 3 ſorts of Spheres; viz. a Parallel, a Right, and an Oblique Sphere.

1. *A* Parallel Sphere.

A Parallel Sphere *has this poſition.*

1. The poles are in the Zenith and Nadir; that is, one pole is right up, and the other

right underneath. 2. The Equator will be in the Horizon.

Property *of this* Sphere.

The inhabitants of this Sphere are thoſe that live under the poles, who have but one day and one night in the year. The day continues ſix months, while the ſun paſſes through ſix of the ſigns of the Zodiac; and the nights ſix months, while he paſſes through the other ſix. The day to thoſe who live under the North pole begins when the Sun enters Aries, and continues till he reaches Libra; when night commences, and continues the other ſix months. Thoſe who live under the South pole, experience the direct contrary, it being day with them when it is night with the former, and *vice verſa*. But both enjoy a long continuance of twilight, both after the ſun has departed, and before he appears.

Tyro. Pray, Sir, what do the polar inhabitants (if there be any) obſerve with reſpect to the ſun, moon, and ſtars?

Philo. 1. They ſee the ſun for half the year, moving continually round above the Horizon, in a ſpiral line, the firſt round ſkimming the ſkirts of the Horizon; the ſecond higher, and ſo on, till by 90 revolutions he has reached the Tropic, his utmoſt declination; after which, by 90 more revolutions, he again reaches the Horizon, and their long winter's night begins.

2. They ſee the moon during their ſummer's day only as a white cloud in the ſky; and in the winter, during her ſecond and third quarters, ſhe moves as the ſun did, round and round for a continuance of ſeveral days without ſetting; being a fortnight above, and a fortnight under the Horizon.

3. They can only ſee that hemiſphere of ſtars between the Pole and the Equator, the feweſt ſeen by any of the inhabitants of the earth. During half a year they ſee none, and their view is but ſhort in the winter's night, by reaſon of the long twilight. To them the ſtars never ſet, but move in circles parallel to the Horizon, keeping always the ſame altitude. The planets are half their time above, and half below the horizon.

2. *A* right Sphere.

A right Sphere *has this poſition.*

1. The poles will lie, or be in the Horizon. 2 The Equator will be in the Zenith and Nadir. 3. The Equator and all the leſſer circles will cut the Horizon at right angles; viz. perpendicularly.

Property *of this* Sphere.

The inhabitants of this Sphere are thoſe who live under the Equinoctial Line, or Equator, and have their days and nights always equal; *viz.* 12 hours each; becauſe not only the Equator, but alſo all the Parallels are cut into two equal parts by the Horizon. And therefore as the ſun's diurnal arches are equal to the nocturnal, each day muſt be equal to the night; *viz.* 12 hours each.

Tyro. How do the ſun, moon, and ſtars appear to the inhabitants under the Equinoctial.

Philo. The ſun riſes and ſets nearly perpendicular, nor can he have more than 23 degrees, 30 minutes, either North or South amplitude. He comes to the meridian with the ſame degree of the Equator with which he roſe; and hence there can be no aſcenſional difference. He is half a year on one ſide of their Zenith, and as much on the other; paſſing over their Zenith but twice a year, viz. at the Equinoxes.

With regard to the moon, there is nothing uncommon, or different in her appearances, from thoſe in an oblique ſphere, except her riſing and ſetting nearly in a perpendicular direction like the ſun.

But here is a glorious diſplay of all the ſtars in the heavens, from pole to pole; all of them riſing and ſetting perpendicular to the Horizon, except the pole ſtars, which lying in the Horizon, are rendered inviſible by the denſeneſs of the atmoſphere. The twilight is ſhorter in this ſphere than in any other, for the ſame reaſon that it is ſhorteſt to us at the Equinox.

3. *An* Oblique Sphere.

An Oblique Sphere is that poſition of the globe, which all the inhabitants of the earth, excepting thoſe under the Poles and Equinoctial, enjoy; and has its name from the circles of the Sphere being cut obliquely by the Horizon.

Properties *of this* Sphere.

1. The pole is elevated to any degree leſs than 90, the axis of the earth always making an acute angle with the Horizon.

2. All the parallels to the Equator cut the Horizon obliquely, making the diurnal greater or leſs than the nocturnal arches; and conſequently producing an inequality in the days and nights, which are never equal but when the ſun is in Aries and Libra, which happens in March and September, when he moves in the Equator, making equal days and nights to all the inhabitants of the earth, except thoſe under the poles.

3. The inhabitants of this Sphere, who live without the tropics, never have the ſun in their Zenith; though they may ſometimes ſee the moon there, on account of her latitude: but under the tropics the ſun is vertical once, and between the tropics and the Equator twice, every year.

4. The ſtars riſe and ſet obliquely in this poſition; and the nearer the obſerver is

ſituated to the Equator, the greater number of them will be viſible. The length of the twilight is longer or ſhorter in this poſition, according as the latitude is greater or leſs.

5. The moon, when at full being always in an oppoſite ſign to the ſun, muſt, in ſummer, be in the winter ſigns, and conſequently make a ſhort, low courſe. But in winter ſhe will move through the ſummer ſigns, making a high, long circuit; which is of great uſe in that dreary ſeaſon.

SECT. IV.

Of the different names of the inhabitants of the Globe, *in reſpect of their ſituation.*

Tyro. YOU have already told me the three different poſitions of the Sphere; pray, what do you mean by the names of the ſeveral inhabitants?

Philo. Without any conſideration of the different poſitions of the ſphere, theſe inhabitants have different names according to the ſeveral meridians and parallels they lie under.

Tyro. Pleaſe to tell me their different names.

Philo. There are 6 different inhabitants; 1. Antœci. 2. Periœci. 3. Antipodes. 4. Amphiſcii. 5. Periſcii. And 6. Heterocii.

1. *Of*

1. *Of the* ANTOECI.

The Antœci, or Antœcians, are thoſe inhabitants that have the ſame longitude with us, that is, lie under the ſame meridian; but they are as far to the S. of the Equator as we are to the N.

Their Property.

1. Their hour is the ſame as ours, it being noon, &c. with both at the ſame time. 2. Their days are equal to our nights, and *vice verſa.* And 3. Their ſummer is our winter.

2. *Of the* PERIOECI.

The Periœcians are thoſe that lie under the ſame parallel of latitude with us, on the ſame ſide of the Equator, only are diſtant 180 degrees of longitude; viz. a ſemi-circle.

Their Property.

1. They have contrary hours, it being noon with them when it is midnight with us. 2. Their days and nights are of the ſame length as ours. 3. Their ſeaſon or time of the year, is alſo the ſame as with us.

3. *Of the* ANTIPODES.

The Antipodes are ſuch inhabitants as have the ſame latitude S. as we have N. but differ 180 degrees in longitude. That is, they have oppoſite parallels, and oppoſite meridians.

Their Property

1. Their hour is directly the reverſe of ours, it being noon with them, when it is midnight with us. 2. Their longeſt day is our ſhorteſt day, and their longeſt night our ſhorteſt night. And 3. The four ſeaſons are contrary, their ſummer being our winter, &c. &c.

Tyro. It is wonderful indeed! I have often heard, it is true, that there are ſuch perſons as walk with their feet to our feet (that is, go with their heads downwards in reſpect of us:) pray are not the Antipodes this ſort of people?

Philo. They are, and however ſtrange it may ſeem, it is certainly true; and this you will eaſily ſee, when you come to the problems, if you will have but a little patience.

Tyro. Sir, I am obliged to you, and will be content till then. Pleaſe now to tell me concerning the other three kinds of inhabitants.

Philo They have their names from the different poſitions of their ſhadows.

4. *Of the* AMPHISCII.

They are ſo called, becauſe their ſhadows are caſt different ways, at noon day, at different times of the year; that is, their ſhadow ſometimes points to the North, and ſometimes to the South. Therefore, it is eaſy to perceive that theſe inhabitants live in the Torrid Zone, that is, between the Equator and the two Tropics.

5. *Of the* PERISCII.

Theſe are ſo called becauſe they have their ſhadows go quite round them. Such are the inhabitants that dwell between the Polar Circles and the Poles, that is, from 66½ degrees of latitude to 90, where the ſun for part of the year never ſetting, but moving round the Horizon, makes the ſhadows of the people likewiſe move around them.

6. *Of the* HETEROSCII.

They are ſo called, as having their ſhadow caſt but one way, that is, either always towards the N. or always towards the S.

Theſe are ſuch as live in the Temperate Zones; that is, between the Tropics and the Polar Circles. Thoſe in the South Temperate Zone have their ſhadows caſt always Southward; and thoſe in the North Temperate Zone have their ſhadows always caſt Northward, as in England, France, Spain, and moſt other parts of Europe.

SECT. V.

Of the ZONES, *or* CLIMATES.

1. *Of the* ZONES.

Tyro. WHAT do you mean by the Zones?

Philo. A Zone, or Girdle, is a tract, or ſpace, that ſurrounds the ſurface of the earth, as a Belt, or Girdle, does the body.

Tyro. How many Zones are there?

Philo. Five; viz. one Torrid Zone, two Temperate Zones, and two Frigid Zones.

Tyro. You gave me an account of their different ſituations in the laſt ſection; be pleaſed, now, to tell me their extent, that I may have a better idea of the diviſion of the globe.

Philo. You remember that I told you from the Equator to either Pole is 90 degrees; therefore, from the N. to the S. Pole is 180 degrees. Obſerve then,

1. The Torrid Zone extends from the Equator to the Tropic of Cancer Northward, and to the Tropic of Capricorn Southward 23½ degrees each way, viz. 47 degrees in all.

2. The Temperate Zones extend themſelves from the two Tropics to the Polar Circles on either ſide the Equator; each of them containing 43 degrees, or 86 degrees together.

3. The Frigid Zones extend from the Polar Circles to the Poles, being each 23½ degrees, or 47 together; for 23½, 43, and 23½, make 90 degrees; the diſtance from the Equator to either Pole. Or rather thus, the Torrid Zone contains 47 degrees,

the Temperate Zones 86, and the Frigid 47, in all 180 degrees.

Tyro. Sir, I thank you for this explanation; it is very eaſy to be underſtood: pleaſe, now, to tell me what you mean by the climates?

2. *Of the* CLIMATES.

Philo. Climates are tracts, or circles upon the ſurface of the globe, parallel to the Equator, of ſuch a certain breadth, that the artificial day in each, (viz. from ſun-riſe to ſun-ſet) exceeds that in the next climate nearer the Equator by half an hour, till you come to the Polar Circles, and then, indeed, the day encreaſes in each Climate by one entire month.

Tyro. How many Climates* are there that differ by the half hour, and how many by the entire month?

Philo. There are 60 Climates in all; viz. 30 on each ſide of the Equator, called accordingly North and South: of theſe 60, 48 extend from the Equator to the Polar Circles, and each differs by half an hour. And the remaining 12 are contained between the Polar Circles and the Poles, each differing one entire month from the other.

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* ***England*** **is in the** ***Climate*** **which reaches from about 51½ to 54½ degrees latitude, that is, about 3 degrees.**

Mid7. 2 1785.

DIALOGUE VII.

An explanation of the moſt common terms uſed in Geography *and* Aſtronomy.

SECT. I.

Tyro. YOU have, Sir, given me a very plain and ſatisfactory account of the nature and properties of the globe: I will now trouble you to explain the terms to me; for what can I do, till I know the ſignification of ſuch words as are uſed in the ſcience.

Philo. It is very true, and I will explain them as well as I am able; and, pray, be careful to get them by heart, though not juſt in the very words I uſe, yet ſo as to know the meaning of them, and the practical part will then eaſily follow; for the want of this is the chief occaſion that moſt learners are ſo deficient in what they undertake.

Tyro. You may depend upon my care.

Philo. Very well; I am ſatisfied, in hopes of your keeping your promiſe.

Explanation *of the* Terms.

1. Zenith, is that point of the heavens that is right over our head.

2. Nadir, is that point right under our feet, being directly, or diametrically, oppoſite to the Zenith.

3. Zenith Diſtance, is the number of degrees that the ſun, or any ſtar, wants of 90 degrees, when they are upon the meridian, or greateſt height.

4. Altitude is height. Meridian Altitude is the greateſt Altitude, or height, at 12 o'Clock.

5. Declination, is the diſtance of the ſun, or any ſtar, from the Equator or Equinoctial, counted on the Brazen Meridian in degrees, and is called North, or South, according to the ſide of the Equinoctial, on which the Declination is.

6. Right Aſcenſion, is an Arch of the Equinoctial, contained between the ſign Aries ♈, and the degree of the Equinoctial that is cut by tne Brazen Meridian, when the ſun, or ſtar, is brought to the Meridian.

7. Oblique Aſcenſion, is that Arch of the Equinoctial contained between the ſign ♈, and the degree of the Equinoctial, which is cut by the Horizon at the riſing of the ſun, or ſtar.

8. Oblique Deſcenſion, is juſt the reverſe, being that arch of the Equinoctial, contained between the ſign Aries and the degree of the Equinoctial. that is cut by the Horizon at the ſetting of the ſun, or ſtar.

9. Aſcenſional Difference, is the difference of degrees, between the right and oblique Aſcenſion, which converted into time, by allowing 15 degrees for every

hour,

hour, ſhews how much the ſun, or ſtar, riſes, or ſets, before, or after ſix. That is, ſubtract the Oblique from the right Aſcenſion, and it will give the aſcenſional difference.

10. Amplitude, is an Arch of the Horizon, contained between the true E. or W. points, and that degree of the Horizon where the ſun or ſtars riſe or ſet, and is called North, or South Amplitude, accordingly.

11. Azimuth, is in effect the ſame as Amplitude, ſave only with this difference; that whereas Amplitude is only at riſing and ſetting, Azimuth ſhews the diſtance from the E. and W. points, at any time, when the ſun, or ſtars, are above the Horizon *.

12. Almacanthers are circles of Altitude paſſing thro' every degree and minute of the Meridian, parallel to the Horizon.

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* *Note, Azimuth* is not expreſſed alike in all authors. Some call it always *North* or *South Azimuth*, and reckon the *Azimuth* from theſe two points eaſtward, or weſtward. Others reckon it from the E. and W. points, either northward, or ſouthward, which, I think, is beſt, theſe being the two points that *Azimuth* is neareſt to in our, or any leſſer latitude, at any hour: however, it matters not which way you reckon, if you mind this one rule; ſuppoſe I ſay, the ſun has 60 degrees *Azimuth* from the N. eaſtward, it is the ſame as if I ſay he has 30 degrees *Azimuth* from the E. northward. See PROBLEM XXI.

13. Elevation of the pole, is the ſame as Latitude. There are three ſorts, viz.

1. Latitude of a place, is its diſtance from the Equator, either North or South, numbered in degrees on the Brazen Meridian: or in other words, it is the Elevation of the pole above the Horizon.

2. Latitude (in Navigation) is the diſtance of a ſhip from the Equinoctial, counted on the Meridian. So that if a ſhip ſails towards the Equinoctial, ſhe is ſaid to depreſs the pole; and, if ſhe ſails from the Equinoctial, ſhe is ſaid to raiſe the pole.

3. Latitude of a ſtar, is its diſtance from the Ecliptic, being an Arch of a circle of longitude, reckoned from the Ecliptic towards its pole, either N. or S.

14. Longitude is alſo of three ſorts; viz.

1. Longitude of a place, is an Arch of the Equator, intercepted between the firſt Meridian (or point Aries ♈) on the Equator and the Meridan of the place*.

***Note*, The *Longitude* of places differs according as you fix your firſt *Meridian*. Thus, upon ſome globes, *London* is 23 degrees E. longitude, on others 20, *&c.* and on all *Senex*'s globes 18 degrees E. longitude from the firſt *Meridian*. For ſome place their firſt *Meridian* at *Gratioſo*, others at *Teneriff*, and *Senex* at *Ferrol*. But this matters not at all; for when you know the difference (as you will ſoon learn that by practice) you will know to work by either, and have the ſame anſwers.

N. B. In reckoning of longitude from *London*, you will find at 18 degrees from *Aries* eaſtward on *Senex*'s globe,

2. Longitude of a ſtar, is an Arch of the Ecliptic, counted from the beginning of Aries, to the place where the ſtar's circle of longitude croſſes the Ecliptic; ſo that it may be ſaid to be the ſtar's place in the Ecliptic, counted from the point Aries, which cannot exceed 180 from the Equinoctial point.

3. Longitude (in Navigation) is an Arch of the Equator, contained between the firſt Meridian and the Meridian the ſhip is in.

Tyro. I humbly thank you, Sir, for theſe definitions, which when well underſtood, muſt render the uſe of the globes very eaſy.

Philo. Indeed, my dear pupil, there can be nothing hard in the practical part, when once you have a tolerable notion of what I have ſhewn you.

But, becauſe I would have you underſtand yet more, I have inſerted the following tables (which are not to be found in any other ſmall treatiſe I ever ſaw) that you may not be at a loſs, when you work any choice Problems, but may be able to refer to them, both for inſtructiou and confirmation.

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globe, a cypher (o) under the lower part of the *Equator,* under the meridian of *London,* and there begins the longitude from *London,* viz. Longitude extends 180 degrees eaſtward, numbered by 10, 20, 30, *&c.* No longitude exceeds 180; for 181 E. is more properly 179 W. longitude.

SECT. II.

Containing three neceſſary and uſeful TABLES; *viz.*

TABLE I.

A TABLE *of the* Latitude *and* Longitude *of the moſt remarkable* Places, from the lateſt *Obſervations.*

N. B. The longitude here is taken from the meridian of London, which is 18 degrees E. of the firſt meridian at Ferrol (on Senex's globe:) ſo that by adding, or ſubtracting, 18 degrees, you have the longitude from the firſt meridian at either place, that is, by knowing one you may know both; the Equator being marked, or graduated, for both.

Places.	Latitude.			Longitude.		
	°	′		°	′	
A						
Adrianople, Turkey, in Europe	42	00	N.	26	30	E.
Aix la Chapelle, in Weſtphalia	50	45		5	50	
Aleppo, Syria, in Aſia	35	45		37	25	
Alexandria, Egypt, in Africa	31	11		30	21	

Places.	Latitude.			Longitude.		
	°	′		°	′	
Amſterdam, in Holland (and capital)	52	23	N.	5	4	E.
Archangel, in Ruſſia	64	34		39	00	
B						
Babylon, in Chaldea (called Bagdad)	34	45		48	45	
Barbadoes, in the Weſt Indies	13	00		59	50	W.
Batavia, Eaſt Indies	6	00	S.	100	00	E.
Bengal, in the Eaſt Indies	22	00	N.	92	45	
Berlin, Upper Saxony, in Germany	52	33		13	30	
Boulogne, Picardy, in France	50	44		1	42	
Boſton, in New England	42	34		70	25	W.
Briſtol, in England	51	28		2	30	
C						
Cadiz, Andaluſia, in Spain	36	33		5	56	W.
Cairo, Egypt, in Africa	30	2		31	31	E.
Candia, in the Iſland of Candia	35	19		25	23	

	°	′		°	′	
Canterbury, in Kent	51	16		1	15	
Canton, in China	23	8		113	8	
Candy, in the Iſland of Ceylon	7	54		81	53	
Cape of Good Hope, S. of Africa	34	15	S.	20	7	
Charles-Town (Carolina) America	33	22	N.	79	50	W
Cochin, Eaſt-Indies	9	50		76	5	E.
Colcheſter, in Eſſex	52	00		0	58	
Conſtantinople, Romania, in Turkey (and capital)	41	00		28	58	
Copenhagen, Zeland, in Denmark (and capital)	55	41		12	50	
Corinth, Morea, in Turkey	37	30		23	00	
Cracow, Poland	50	15		20	50	
Cremona, Milan, in Italy	45	10		10	32	
Cyprus Iſland, in the Levant	35	00		34	00	
D						
Dublin, capital of Ireland	53	12		6	55	W.
Dunkirk, Flanders	51	2		2	27	E.

Places.

Places.	Latitude.			Longitude.		
E	°	′		°	′	
Edinburgh, capital of Scotland	55	58	N.	3	00	W.
Epheſus, Natolia, in Aſia	38	00		27	35	E.
F						
Frankfort, on the Oder, in Germany	52	28		14	35	
Frankfort, on the Main, in Germany	49	45		9	45	
G						
Gibraltar, Andaluſia, in Spain	36	13		4	53	W.
Glaſgow, in Scotland	55	52		4	5	
H						
Hague, in Holland	52	10		4	4	E.
Hanover, Saxony, in Germany	52	16		10	0	
J						
Jeruſalem, Paleſtine, in Aſia	31	50		35	25	
K						
Koningſburgh, Pruſſia, in Poland	5.	55		22	15	

	°	′		°	′	
L						
Lisbon, capital of Portugal 50 . 43	38	42	N.	8	52	
London, capital, or metropolis, of England	51	32		0	0	
M						
Madagaſcar, an iſland in Africa	19	29	S.	43	55	E.
Madrid, New Caſtile, in Spain (and capital)	40	25	N.	3	39	W.
Malta, near Sicily, in Mediterranean	35	54		14	34	E.
Mexico, America	20	00		103	00	W.
Moſcow, Ruſſia	55	45		37	51	E.
N						
Nankin, or Nanquin, in China	32	7		118	35	
Naples, in Italy	40	51		14	45	
O						
St. Omer's, in France	50	50		2	20	
P						
Panama, America	8	45		79	55	W.

Places.	Latitude.			Longitude.		
	°	′		°	′	
Paris, capital of France	48	50	N.	2	25	E.
Pekin, in China	39	54		116	52	
Peterſburgh, the capital of Ruſſia	60	00		30	25	
Philadelphia, America	40	50		74	00	W.
Port Royal, Jamaica	17	40		75	52	
Prague, capital of Bohemia, in Germany	50	00		14	25	E.
Preſburgh, in Hungary	48	22		15	30	
Q						
Quebec, in Canada	46	55		69	48	W.
R						
Rhodes Iſland, Archipelago	36	00		29	15	E.
Rome, capital of Italy	41	54		12	45	
S						
Siam, in the Eaſt-Indies	14	18		100	55	
Spires, Upper Rhine, Germany	49	0		8	10	

8.6

	°	'	°	'	
Stockholm, capital of Sweden	59	20	18	8	
Syracuſe, Sicily	37	4	15	20	
T					
Tangier, Barbary, in Africa	35	55	5	45	W.
Thyatira, Natolia, Aſia	38	28	28	32	E.
Tripoli, Barbary, Africa	32	54	13	10	
Tunis, ditto	36	47	10	16	
V					
Venice, Italy	45	25	12	20	
Vienna, Germany (capital)	48	13	16	28	
W					
Warſaw, the capital of Poland	52	14	21	10	
Y					
York, in England	54	00	1	8	W.
York (New) America	41	5	74	51	

TABLE II.

Shewing the ſun's place, declination, time of riſing and ſetting; length of days, and beginning and ending of twilight, one day in every month, for the latitude of London, *according to the* New Stile, 1770.

N. B. (°) ſtands for degrees (′) for minutes, H. for hours, M. for minutes, ☉ for the Sun, D. for declination, N. for North, S. for South.

Months.	☉'s place			Declin.		☉'s Riſ. and Set.			L. of Days.		Twilight beg.		ends.
		°	′	°	′	H	M.	H.	H	M	H.	M.	H.
Jan. 20	♒	1.	45	19.	51 S	7.	48	5	8.	24	5.	43	7
Feb. 19	♓	1.	55	10.	31 S	6.	55.	6	10.	10	5.	00	7
Mar. 22	♈	2.	50	1.	4 N.	5.	56.	7	12.	8	4.	00	8
Apr. 22	♉	2.	14	12.	13 N.	4.	48.	8	14.	24	2.	38	10
May 22	♊	1.	11	20.	25 N.	4.	8.	8	15.	44	12.	30	12
June 22	♋	1.	0	23.	29 N.	4.	42.	8	16.	36	No night till *July* the 20th		
July 21	♌	28.	30	20.	24 N	4.	7.	8	15.	46		42	12
Aug. 20	♍	27.	17	12.	29 N.	4.	53.	8	14.	14	2.	21	10
Sept. 19	♎	26.	27	1.	29 N	5.	51.	7	12.	14	4.	00	8
Oct. 19	♏	26.	6	10.	1 S.	6.	50.	6	10.	20	5.	00	7
Nov. 18	♐	26.	14	19.	18 S.	7.	43.	5	8.	34	5.	45	7
Dec. 22	♑	1.	45	23.	19 S.	8.	12.	4	7.	36	5.	58	7

TABLE III.

A TABLE *of the right* Aſcenſion, Declination, Latitude, *and* Longitude *of ſome of the moſt eminent fixed* Stars, *taken from* Senex's *Celeſtial* Globe, 1754, *for the uſe of the learner.*

Names and Conſtellations.	R. A.		Declin.			Lat.			Long.		
	°	′	°	′		°	′		°	′	
Aldebaran, in Taurus	65	15	16	15	N.	4	45	S.	6	00	♊
Alioth, in Urſa Major	189	30	57	30		54	00	N.	6		♍
Alcair, in Aquila	293	45	8	30		29	30		28		♑
Albiero, in Cygnus	289	45	27	30		48	00		28		♑
Aridef, in ditto	307	45	44	30		59	30		3	30	♓
Acharnar, in Eridanus	23	30	59	30	S.	60	0	S.	13	00	♓
Alfeta, in Corona	230	45	27	15	N.	43	32	N.	8	00	♏
Arcturus, in Bootes	210	45	20	30		30	30		23	00	♎
Afengue, in Lyra	277	00	38	30		61	[illegible]		11	00	♑

Bellatrix,

Names and Conſtellations.	R. A.		Declin.			Lat.			Long.		
	°	′	°	′		°	′		°	′	
Bellatrix, in Orion	77	30	6	15		15	45		17	00	♊
Betelgeuze, in ditto	84	30	7	30		24	30		26	15	
Benenaez, in Urſa Major	204	15	50	30		54	30	N.	23	00	♍
Canobus, in Argo Navis	95	30	53	0	S.	76	00	S.	5	00	♋
Caſtor, in Gemini	109	30	32	30	N	9	45	N.	16	00	
Caſtor's brother, Pollux, ditto	111	45	28	30		7	00		19	30	
Capella	73	00	45	45		23	00		17	00	♊
Cor Hydræ, Hydra's Heart	138	30	8	15	S.	22	30	S.	24	00	♌
Cor Scorpionis, Scorpio's Heart	243	00	26	00		4	45		5	45	♐
Cor Leonis, called Regulus	148	00	13	00	N.	0	45	N.	26	00	♌
Deneb, in Leo Major	173	45	16	30		12	30		18	00	♍
Dubbee, in Urſa Major	175	00	55	30		47	30		27	30	♌
Enif, in Pegaſus	322	15	8	45		22	30		28	00	♒
Fomahant	341	00	31	0	S.	21	00	S.	30	00	
Marhal, in Pegaſus	342	15	13	30	N.	19	00	N.	20	00	♓

	°	′	°	′		°	′		°	′	
Mencar, in Cetus	41	36	3	15		12	00	S.	10	00	♉
Procyon, in Canicula	111	00	6	00		15	00		22	00	♋
Pes Centauri	216	30	59	30	S.	42	30		26	00	♏
Regel, in Orion's Foot	75	15	9	15		31	00		12	30	♊
1. Star, in the Girdle of Orion	79	30	1	00		23	00		17	30	
2. —— ditto	80	30	2	00		24	00		18	30	
3. —— ditto	81	15	3	00		25	30		19	30	
Scheat, in Pegaſus	342	15	26	15	N.	31	00	N.	26	00	♓
Sheder, in Caſſiopeia	5	30	55	15		46	30		3	80	
Sirius, in Canis Major	98	00	16	30	S.	39	15	S.	12	00	♉
Spica, in Virgo	198	00	9	45		2	00		20	00	♎
Upper Pointer, in Urſa Major	161	30	63	30	N	50	00	N.	12	00	
Lower Pointer, ditto	161	20	58	00		46	00		16	00	
Vindemiatrix, in Virgo	192	00	12	30		16	00		5	30	♎

DIA-

DIALOGUE VIII.

Containing ſome uſeful and neceſſary Problems *on the* Terreſtrial Globe.

N. B. (°) ſtands for degrees, (′) for minutes.

SECT. I.

Philo. YOU ſay, *Tyro*, that you underſtand what I have ſhewn you concerning the nature of the globes, and the appendants that belong to them; and, if ſo, you are fit for the following problems: but, if you think you are not perfectly maſter of theſe ſubjects, or do not underſtand what right Aſcenſion, oblique Aſcenſion, Azimuth, Almacanthers, &c. ſignify, or do not know what the greater or leſſer circles are, and the particular uſes of the Meridian, Horizon, Colures, Quadrant of Altitude, &c. then, pray, turn back, and read them over once more; for you will find that your underſtanding theſe will be a great help to you in the ſolution of geographical problems.

Tyro. I thank you for your care; but I underſtand them in general very well.

Philo. Then I will directly proceed to

PROB. I.

The latitude being given, to rectify the Globe *for that place.*

DEFINITION.

I Have already told you, that the latitude of any place is the ſame thing as the elevation of the pole above the Horizon; therefore, whatever the latitude be, ſuppoſe that of London 51° 32′ N. or that of Madrid 40° 25′ N. proceed thus

Turn the pole on which the dial-plate is fixed towards the Verge of the Horizon, ſlipping or moving the whole globe backwards or forwards, in the notches of the Horizon, till the Horizon cuts the Brazen Meridian, in 51° 32′ (viz. a little more than 51½) ſo is the globe rectified for the latitude of London; that is, the N. pole will then be elevated 51° 32′ above the Horizon; and London being brought to the meridian itſelf will then be in the Zenith, or right up, and at an equal diſtance from all parts of the Horizon.

Depreſs the pole till the Horizon cuts the Brazen Meridian at 40° 25′, and you have then the poſition of the inhabitants at Madrid, and turning the globe, till Madrid comes to the meridian, you will find it in the Zenith, or top of the globe, under 40° 25′.

Note. If it were required to rectify the globe for S. latitude, then you muſt elevate the S. pole to the given latitude inſtead of the N. pole; but this is better explained by the next problem.

PROB. II.

The latitude and longitude of any place being given, to find the ſame.

Firſt, YOU are to obſerve whether the longitude be reckoned from London, or from any other firſt meridian; for on ſome globes the firſt meridian begins at 23°, on others at 20°, and on Senex's globes at 18° W. from London; but, if once you know where the firſt meridian is on the globe, it is very eaſy to know the difference between that and the meridian of London, ſuppoſing it to begin from another place. As in moſt Engliſh authors the tables of longitude are counted from the meridian of London, I here follow the ſame method.

See a farther account of longitude, DIALOGUE VII. Sect. I. Defin. XIII.

EXAMPLE.

There are two certain places; one has 17° 40′ N. latitude, and 77° 52′ W. longitude. The other has 34° 15′ S. latitude, and 20° 7′ E. longitude from London; I demand what places theſe are?

RULE.

For the firſt place, I elevate the N. pole to 17° 40′, becauſe it is 17° 40′ N. latitude. Then I turn the globe to the right-hand, or eaſtward, (becauſe the place lies weſtward) till 77° 52′ upon the Equator, counted from the meridian of London (which on Senex's globe has a cypher thus (o) on the equator) paſſes through, or under, the meridian; or, in other words, I turn the globe, till 77° 52′ weſtward is brought under the meridian, and here I fix the globe with a quill thruſt in betwixt the globe and the Horizon: then I look under the latitude 17° 40′ (which is in the Zenith) on the meridian a-top of the globe, and under 17° 40′ on the meridian, I find Port Royal in Jamaica, the place required.

For the ſecond place, I elevate the S. pole (though there is no occaſion to elevate the pole barely to find a place; but it is better to do ſo, becauſe you have then the real ſituation of the inhabitants) to the given latitude 34° 15′, and then turn the globe till 20° 7′ E. longitude from London come under the meridian. Then I look under the latitude 34° 15′ on the meridian, and juſt under this I find the Cape of Good Hope, the place required.

Again, There are 3 places. The firſt 31° 50′ N. latitude, and 35° 25′ E. longitude.

tude: the ſecond is 39° 54′ N. latitude and 116° 52′ E. longitude: and the laſt is 7° 54′ N. latitude, and 81° 53′ E. longitude; I demand the places.

Anſwer, Jeruſalem, Pekin, and Candia, or Candy.

PROB. III

The latitude of any place being given, to tell all thoſe places that have the ſame latitude.

DEFINITION.

ALL thoſe places, that have the ſame latitude, have the days and nights of the ſame length, at the ſame time; but not the very ſame hour of the day. See Sect. IV. Defin. II.

RULE.

Bring the given place, or places, to the meridian (ſuppoſe London 51° 32′, or Madrid 40° 25′ N.) then turn the globe, and all thoſe places that paſs under 51° 32′, have the ſame latitude as London; viz. Prague, in Germany, &c. and all that paſs under 40° 25′, have the ſame latitude as Madrid, which you will find to be Pekin nearly; for a few minutes are not to be minded in ſuch caſes.

PROB. IV.

To tell the difference of the latitude of places.

HERE are two variations, or rules. Firſt, If the latitudes be both N. or both S. then ſubtract the leſs from the greater latitude, and the remainder is the difference, or anſwer. Thus between London and Madrid is 11° 7′, the firſt being 51° 32′, and the other 40° 25′. And between Candy and Stockholm is 51° 26′, for Stockholm is about 59° 20′ N. and Candy 7° 54′ N.

Secondly, If one place lie on the N. and the other on the S. ſide of the Equator; that is, if one be N. and the other S. latitude, then add them both together, and their ſum is the difference of the latitude required.

Thus, Copenhagen is 55° 41′ N. and the iſland of Madagaſcar is 19° 29′ S. theſe added together make 75° 10, the difference required.

PROB. V.

The longitude of any place being given from any meridian, to tell thoſe places that have the ſame longitude.

THIS is done after the ſame manner as the other, only here the anſwer will be on the Equator, as the others were on the Meridian.

I would know what places have the ſame longitude as London, and the ſame longitude as Moſcow.

RULE.

Bring London to the meridian, then all thoſe places on the globe (from the N. pole to the S.) that lie under the edge of the meridian, have the ſame longitude as London. Thus, Fort Naſſau, and Fort Mina in Guinea have the ſame, or very nearly the ſame longitude as London.

And Moſcow in Ruſſia has very nearly the ſame longitude as Aleppo in Syria: alſo Scandaroon, Antioch, and Tripoli in Syria have the ſame longitude; viz. 37° 51′ from London.

PROB. VI.

To tell the difference of the longitude of places. (*See* Prob. XXVI.)

DEFINITION.

☞ *Note* 1. No place can exceed, or be above 180 d. of longitude from another place; for 181 d. E. longitude is with more propriety 179 d. W. longitude, for 181 d. taken from 360 d. there remains 179 d. which is nearer to the given place than 181 d.

RULE.

RULE.

HERE are alſo two variations as in Prob. IV. Firſt, If the places lie both E. or both W. of the firſt meridian, or the line you reckon the longitude from; viz. if they both have E. or both W. longitude, then ſubtract one from the other, you have the difference.

Thus, I find Jeruſalem has 35° 25′ E. longitude from London, and Pekin 116° 52′ E. longitude; therefore, I ſubtract 35° 25′ from 116° 52′, and there remains 81° 27′ difference of longitude E. or W. that is, Pekin is in 81° 27′ E. longitude from Jeruſalem; or Jeruſalem is 81° 27′ W. longitude from Pekin.

Secondly, If one place have E. and the other W. longitude from the firſt meridian (ſuppoſe London, or any other meridian) then add their longitudes together, and the ſum is the difference of longitude required.

EXAMPLE.

I would know the difference of longitude between Jeruſalem 35° 25′ E. of London, and Port Royal in Jamaica 75° 52′ W.

Here as one is E. and the other W. I add 35° 25′ and 75° 52′ together, and their ſum makes 111° 17′ the difference of longitude. That is, Jeruſalem is 111° 17′ E. of Port Royal, or Port Royal is 111° 17′ W. of Jeruſalem.

Note 2. If the difference of longitude after addition exceeds 180 d. take it out of 360 d. for that is the true longitude required. See *Note* 1.

EXAMPLE.

Pekin in China is 116° 52′ E. longitude, and Port Royal is 75° 52′ W. I add theſe ſums together, and find it 192° 44′ difference of Longitude; but, becauſe, it is more than 180°, I ſubtract 192° 44′ from 360°, and there remains 167° 16′, the difference required.

Tyro. Sir, I heartily thank you for this explanation, which I underſtand very well.

PROB. VII.

The day of the month being given, to find the ſun's place in the ecliptic.

RULE.

THE day of the month being given, look on the inner calendar on the new globes, and you have the ſign and the degree of that ſign that the ſun is in on that day, according to the New Stile.

If it be upon old globes, look on the outward calendar, you have the ſign and the degree of the ſign.

N. B. You may further obſerve, that the calendar uſed throughout Europe is the calendar for N. S. viz. New Stile, and is always known from the other, becauſe it has the Saints Days, and ſeveral other things wrote upon it on the Horizon.

EXAMPLE.

I would know the ſun's place in the ecliptic, on May the 21ſt, N. S. March the 21ſt, June the 21ſt, September the 22d, and December the 21ſt.

I look for theſe days of the months in order as they ſtand in the new calendar; viz. for N. S. before deſcribed, and right againſt the day of the month in the innermoſt circle on the Horizon, I find the ſun's place among the ſigns.

Thus, right againſt May the 21ſt, I find 1° of ♊ Gemini: and alſo on March the 21ſt, I find he enters ♈ Aries: on June the 21ſt, he enters ♋ Cancer: on September the 22d, he enters ♎ Libra: and on December the 21ſt, he enters ♑ Capricorn.

☞ *Note*, That in every problem and operation, except Old Stile be mentioned, it is to be underſtood for New Stile; viz. N. S. and latitude always means N. latitude, except expreſſed S.

PROB VIII.

The ſun's place being given. to find the day of the Month.

RULE.

THIS is only the reverſe of the former problem: for having the ſun's place given, ſeek it in the innermoſt circle among the ſigns; then againſt that degree in the calendar N. S. you have the day of the month required.

EXAMPLE.

I would know what time of the year the ſun is in 1° of ♊, as alſo when he enters ♈, ♋, ♎, and ♑. Proceed according to the rule, and you will find the days to be May the 21ſt, March the 21ſt, June the 21ſt, September the 22d, and December the 21ſt.

PROB. IX.

The latitude and day of the month being given, to find the ſun's place in the ecliptic, and rectify the globe for uſe.

RULE.

FIND the ſun's place on the Horizon by Prob. VII. and having noted what degree he is in, look upon the ecliptic on the globe, and find the ſame ſign and degree as you did on the Horizon, then bring this degree of the ecliptic very carefully to the graduated edge of the Brazen Meridian, and holding the globe ſteady, turn the index exactly to the upper 12, which repreſents 12 at noon, and thus is the globe rectified for that day, and the degree of the ecliptic that lies under the Equator, repreſents the ſun's place at noon, or 12 o'clock that day.

☞ The Aſtronomical day is reckoned from, or begins at, 12 o'clock; and, if you fix the quadrant of altitude to the latitude in the Zenith, the globe will be completely rectified; but more of this by and by.

PROB. X.

To tell the declination of the ſun on any day of the year.

DEFINITION.

DEclination of the ſun is his variation from the Equator, either northward, or ſouthward.

N. B. His greateſt declination northward is 23 d. 30 m. which is on June the 21ſt, and his greateſt declination ſouthward is 23 d. 30 m. December the 21ſt; but on March the 21ſt, and September the 22d, when he enters ♈ and ♎, he has no declination at all, but is in the Equator itſelf; and then days and nights are equal to all the inhabitants on the globe.

RULE.

RULE.

Having found the ſun's place in the ecliptic for the given day, bring it to the Brazen Meridian, and obſerve what degree of the meridian it lies under, and whether it be on the N. or on the S. ſide of the Equator, for that is the declination required, which is called N. or S. declination accordingly.

EXAMPLE.

Proceed according to the rule, you will find on April the 21ſt, the ſun has 11° 30′ N. declination, and on May the 21ſt, he has 20° 30′ N. declination: but on October the 27th, he has 12° 30′ S. declination, and on January the 30th, he has 16° S. declination nearly.

PROB. XI.

The latitude and day of the month being given, to tell the ſun's meridian altitude; viz. *his height at noon.*

RULE.

BRING the ſun's place to the meridian, and obſerve what degree of the meridian the ſun's place is under; for thoſe degrees on the meridian that are intercepted, or lie between the South verge of the Horizon, and the degree which is over the ſun's place on the meridian, counted on the meridian, is the ſun's meridian altitude required.

EXAMPLE.

I would know in the latitude 51° 30′, on May the 21ſt, the ſun's meridian altitude, as alſo his meridian altitude on November the 5th. I proceed according to the rule, and find his meridian altitude, May the 21ſt, to be 59°; but on November the 5th, he has but 23° 30′ altitude.

Proceed thus, and you will find his meridian altitude, in the latitude of 40°, on the ſame days, to be 70° 30′, and 34° 30′: but in the latitude of 20° 30′, on May 21, he will have 90° of altitude, or be right over head that day to the inhabitants in that latitude, which ſhall be further explained by and by.

PROB. XII.

The latitude of the place (ſuppoſe London) *and ſun's meridian altitude being given, to tell the day of the month ſuppoſing it were loſt.*

RULE.

THIS problem is the reverſe of the laſt; for you are only to ſet the globe to the latitude, then count from the S. verge of the Horizon, as many degrees on the meridian upwards as the given height is; and under that degree of the meridian you have the ſun's place in the ecliptic, which ſeek in the circle of ſigns on the Horizon, and it gives the day required.

EXAMPLE.

In the latitude of 51° 30′, on two certain days, I obſerved the ſun's meridian altitude to be 59° and 23° 30′; I demand what days they are?

Proceed according to the rule, you will find the one to be May 21, the other November 5.

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PROB. XIII.

The latitude and day of the month being given, to tell the ſun's altitude at any time.

EXAMPLE.

ON May the 21ſt, at 9 in the morning, and at 5 in the afternoon at London, I would know the ſun's altitude.

RULE.

Rectify the globe for the latitude, and bring the ſun's place (1° ♊) to the meridian, and the index to the upper 12 on the dial-plate; then fix the quadrant of altitude in the Zenith; (viz. the left edge of the nut muſt be fixed on the meridian at 51° 30′) then turn the globe till the index points to the hour, viz. 9 in the morning; this done, fix the globe by thruſting in a quill between it and the Horizon; laſtly, turn the quadrant about, till the graduated or figured edge touch the ſun's place (viz. 1° ♊) and the degrees on the quadrant, counted from the Horizon upward on the quadrant, is his height at that time; viz. 43° 30′. Then turn the globe till the index points to 5 in the afternoon; and alſo turn the quadrant on the W. ſide (without unſkrewing it) till it touches the ſun's place; and you have about 24° on the quadrant, his altitude at that time.

But at North Cape (viz. N. latitude 72) at 9 in the morning May 21, he will be but about 32° high.

PROB. XIV.

The latitude (ſuppoſe London) *and the ſun's altitude and day of the month being given, to tell the hour.*

THIS is but the reverſe of the laſt problem, only it will have two anſwers; viz. the hour may be either morning or afternoon.

RULE.

Rectify the globe as before directed, and turn the globe and the quadrant on the E. ſide, till the quadrant touches the ſun's place at the given height, (which by the laſt, on May 21, at 9 in the morning, was found 43° 30′,) then look at the index, and it will point to the hour; turn it W. till the ſun's place touch the ſame degree on the quadrant on the W. ſide, and you will have the time in the afternoon.

EXAMPLE.

Thus on May the 21ſt, at London, when the ſun is 43° 30′ high, it is either 9 in the morning, or 3 in the afternoon.

Note. When the ſun's place and quadrant are on the E. ſide of the meridian, it is morning hours; but when the ſun's place is on the W. part of the meridian, or weſtward of it, it is afternoon.

PROB. XV.

The latitude being given, to tell the riſing and ſetting of the ſun, and length of the day and night at any time of the year.

RULE.

REctify the globe (viz. elevate it for the latitude, bring the ſun's place to the meridian, and index to the upper 12,) then turn it till the ſun's place comes even with or lies againſt the inner verge on the E. ſide of the Horizon, then the index will ſhew you the time of the ſun's riſing; turn it to the W. ſide or verge of the Horizon, and the index will ſhew you the ſetting. Or thus: having got the hour the ſun riſes, count how many it wants of 12; for ſo many hours will it ſet after 12. Thus; if the index points to 4 in the morning at riſing, it will of courſe ſet at 8 at night; if it points any day at half an hour paſt 7 at riſing, it will ſet at half an hour paſt 4; both being four hours and a half from 12 at noon.

Note 1. If you double the time of riſing, that is, double the hours it wants of 12 at the time of riſing, it gives you the length of the Day from ſun-riſing to ſetting.

Note 2. If you ſubtract the length of the Day from ſun-riſing to ſun-ſetting, from 24, the remainder ſhews you the length of the night, twilight included. See Prob. XXV.

Proceed thus, and you will find the ſun, on May 26, at London, to riſe about 4 in the morning, and ſet at 8 at night. Now double what he wants of 12 at riſing, viz. 8 hours, and it gives the length of that day at London, viz. 16 hours.

But at Madrid, on the ſame day he riſes about ¾ paſt 4, ſets ¼ paſt 7 at night. And at Stockholm, on the ſame day he riſes at about ¼ paſt 3, and conſequently the days are 17½ hours long there.

PROB. XVI.

To tell the length of the longeſt and ſhorteſt day at London, *latitude* N. 51° 30′, *and at* Stockholm, *latitude* N. 59° 20′.

RULE.

YOU proceed the ſame way in this as in the laſt problem, only inſtead of bringing 1° of ♊, as before, you now work with 1° of ♋, or rather 30 of ♊, for then the ſun enters Cancer on June 21, or longeſt day.

You will find him, therefore, riſe at London, June the 21ſt, at 42 m. paſt 3 in the morning, which wants 8 h. 18 m. of 12; this doubled gives 16 h. 36 m. for the longeſt day at London.

Then work with ♑ Capricorn for the ſhorteſt day; viz. bring ♑ Capricorn to the meridian, and the index to 12, and you will find the ſun riſes 18 m. paſt 8, which wants 3 h. 42 m. of 12: this doubled gives 7 h. 24 m. the length of the ſhorteſt day, which added to 16 h. 36 m. the longeſt day, gives 24 h. for day and night.

Thus you ſee the length of the longeſt day in ſummer, is the ſame as the length of the longeſt night in winter.

Proceed now for Stockholm (viz. 59° 20′ N. latitude) after the ſame manner, you will find the longeſt day to be about 18½ h. and the ſhorteſt 5½ h. And thus, for any latitude,

tude, or place, not exceeding 66½ d. for there the days will be 24 h. and, if you go to a greater latitude, either N. or S. you will find them 30 h. long, 2, 3, 4, or 5 days, or 2, 3, 4, or 5 weeks, or as many months, which I ſhall explain in a problem by itſelf by and by.

Tyro. This is a little ſurpriſing, indeed, and at preſent I muſt own ſeems very ſtrange to me.

Philo. I aſſure you it is not more ſtrange than true, as you will plainly perceive when we come to treat of it.

PROB. XVII.

To tell the ſun's right aſcenſion.

WHAT right aſcenſion is, you will find in Dial. VII. Sect. I. Art. VI.

Bring the ſun's place to the Brazen Meridian, and note what degree of the Equator is cut by the meridian, for that is his right aſcenſion required.

EXAMPLE.

I would know the ſun's right aſcenſion, on March the 21ſt, June the 21ſt, September the 22d, and December the 21ſt.

I find the ſun's place for theſe different days, and bringing it to the meridian, I find the meridian cuts the Equator in (0)

(90) in (180) and in (270°) his right aſcenſion required.

Note. When the ſun enters ♈, March the 21ſt, he has no right aſcenſion, becauſe it is counted from, or begins at ♈; therefore, on March the 20th, he muſt have his greateſt right aſcenſion; viz. 359°.

PROB. XVIII.

To find the ſun's oblique aſcenſion and deſcenſion at any time, and in any latitude.

See Oblique Aſcenſion and Deſcenſion, Dial. VII. Sect. I. Article VII, VIII.

N. B. Though the latitude is not required in finding the right aſcenſion, becauſe the Equator will be cut in the ſame place by the meridian, whether the pole be elevated or depreſſed; yet in the oblique aſcenſion, the Horizon will cut the Equator in different degrees acccording to the latitude, as will appear from the work and your own reflection.

RULE.

1. RECtify the globe, and bring the ſun's place down to the eaſtern verge of the Horizon; then obſerve what degree the Horizon cuts the Equator in, for that is the oblique aſcenſion required.

2. Turn the globe till the ſun's place comes to, or lies level with the weſtern verge of the Horizon, and the degree of the Equator cut by the Horizon, is the oblique deſcenſion required.

Thus on March the 21ſt, June the 21ſt, September the 22d, and December the 21ſt; viz. when the ſun enters ♈, ♋, ♎, and ♑, you will find his oblique aſcenſion at London to be (0) (56) (180) and (304.)

And on the ſame days his oblique deſcenſion will be (0) (123) (180) and (237½.)

PROB. XIX.

The latitude and day of the month being given, to tell the ſun's aſcenſional difference; viz. *how much he riſes or ſets before and after* 6; *and, conſequently, to tell the length of the days, ſuppoſe there were no index to the globe.*

RULE.

BY Prob. XVII. and XVIII. find the ſun's right, and oblique aſcenſion; then ſubtract the oblique from the right aſcenſion, or the contrary, and the remainder is the aſcenſional difference required; which divide by 15, the degrees of the Equator that paſs through the meridian in 1 hour (or 7½ in ½ an hour) and the quotient gives the anſwer in time that the ſun riſes and ſets before and after 6. See an example in figures, how to convert degrees and minutes into time, Prob. XXVI.

EXAMPLE *for* LONDON.

On May the 26th, I find the ſun 6 d. of ♊, and his right aſcenſion is 64 d. and on the ſame day his oblique aſcenſion is 34 d. now 34 d. from 64 d. there remains 30 d. his aſcenſional difference; which divide by 15, and the quotient gives two hours, the time that he riſes before, or ſets after, 6.

This you may prove by Prob. XV. for you will find he riſes at 4, and ſets at 8, May the 26th.

But on December the 6th, his right aſcenſion is 256 d. and his oblique aſcenſion is 286 d. their difference is 30 d. which is two hours, that he riſes after, or ſets before, 6.

N. B. The right exceeds the oblique aſcenſion from ♈ to ♎, when the ſun riſes before 6; but the other half year that he riſes after, or ſets before, 6, the oblique exceeds the right aſcenſion.

PROB. XX.

The latitude and day of the month being given, to find the ſun's amplitude; viz. his diſtance from the E. and W. points at his riſing and ſetting, and the points of the compaſs he riſes and ſets upon.

RULE.

THE globe being rectified, bring the ſun's place to the eaſtern verge of the Horizon (which ſhews his riſing) then the degrees upon the innermoſt circle of the Horizon, counted from the true E. point to the place which the ſun's place lies againſt on the Horizon, ſhew you the ſun's amplitude.

EXAMPLE *at* LONDON.

Proceed according to the rule, you will find the ſun's amplitude (May the 21ſt) at riſing to be about 34° from the E to the N. and at ſetting 34° from the W. to the N. and the point he riſes upon is N. E. by E. and he ſets N. W. by W. But on November the 5th, he has about 25½ d. amplitude from the E. to the S. and at ſetting 25½ d. from the W. to the S. The point he riſes upon is E. S. E. and the point he ſets upon is W. S. W.

PROB. XXI.

The latitude and day being given, to find the ſun's Azimuth; *viz. his diſtance from the* E. *and* W. *or from the* N. *and* S. *points at any time.*

See Azimuth, Dial. VII. Sect. I. Article XI.

RULE.

REctify the globe in general, then turn the globe till the index points to the given hour; this being done, turn the quadrant, till it touches the ſun's place for the given day; and then the quadrant will cut the Horizon in the Azimuth required from the E. or W. points, or from the N. or S. points, for you may reckon from either, only then name it properly and accordingly.

Thus on Auguſt the 17th, at 9 in the morning, the ſun will have about 30° Azimuth from the E. to the S. or, which is the ſame, 60° from the S. to the E. for 60° and 30° make 90° the whole quarter from E. to S.

N. B. Some authors call this 60 d. S. amplitude; but others call it 30 d. S. amplitude; that is, 30 d. from the E. to the S. as I ſaid before.

This will appear yet plainer, if we would know the Azimuth of the ſun the ſame day, at 11 in the morning; which is 68½ d. from the E. to the S. or 21½ from the S. to the E.

But on May the 21ſt, at 3 in the afternoon, he will have 25° Azimuth from the W. to the S. viz. 65° Azimuth from the S. to the W. And at ¾ paſt 5, his Azimuth is 10° from the W. to the N. or 80° from the N. to the W.

Tyro. Sir, I underſtand the demonſtration quite well; but how am I to expreſs, or name, the Azimuth in general?

Philo. By the words North and South, becauſe it will always be either northward or ſouthward, reckoning from the E. and W. points, either North or South.

Thus as before, Auguſt the 17th, at 9 in the morning, the ſun has 39° S. Azimuth (viz. from the E. point ſouthward) but on May the 21ſt, at ½ h. paſt 4 in the morning, he has 30° N. Azimuth; viz. 30° from the E. northward.

PROB. XXII.

The latitude and azimuth being given on any day, to tell the hour, or time of the day.

RULE.

THIS is the reverſe of the former problem, for the globe being rectified, turn the quadrant of altitude to the given degree of Azimuth (from the E. or W. point on the Horizon) and there hold, or ſteady, the quadrant with one hand, and with the other turn the globe, till the ſun's place for the given day touches the figured edge of the quadrant, and the index will point to the hour, or time, required.

EXAMPLE *for* LONDON.

On Auguſt the 17th, I obſerved the ſun's Azimuth to be 39° from the E. to the S. I would know the hour. Anſwer, 9 in the morning.

Again, on May the 21ſt, I find his Azimuth 10° from the W. to the N. what is the hour? Anſwer, ¼ paſt 5 in the afternoon.

PROB.

PROB. XXIII.

The latitude, day, and hour being given, to tell the ſun's almacanther.

DEFINITION.

ALmacanthers are circles of altitude that run parallel to the Horizon, whoſe poles are the Zenith and Nadir; ſo that you may imagine as many circles of altitude, viz. almacanthers, as you pleaſe.

RULE.

The almacanther is found the ſame way as the altitude of the ſun at any time; therefore, I refer you back to Prob. XIII.

E. Tmas 1788.

PROB. XXIV.

The latitude and ~~length of the~~ day being given, to tell what other day of the year will be of the ſame length.

RULE.

HAVING found the ſun's place for the given day, bring it to the meridian, and obſerve well its declination; then turn the globe till ſome other degree of the ecliptic comes under the ſame degree of declination under the meridian; this being done, ſee what day of the month anſwers to the ſun's place then under the meridian, for that is the day required; which you may eaſily prove by Prob. XV.

I would know what day is of the ſame length as May the 26th, and of the ſame length as April the 17th. Anſwer, July the 13th, and Auguſt the 20th.

Note, Theſe laſt 8 Problems, as alſo Prob. IX. and X. are common to both globes; but are inſerted here, becauſe many perſons have a terreſtrial, that have not a celeſtial globe.

The following Problems more particularly concern, or belong to, the terreſtrial globe.

PROB. XXV.

The latitude and day of the month being given, to tell the beginning, ending, and (conſequently) the length, or continuance, of twilight.

DEFINITION.

TWilight is that faint light which begins immediately after the ſun ſets in the evening, till he is 18° below the Horivon; and it begins in the morning, when the ſun comes within 18° of the Horizon on the E. ſide, and ends when he riſes. Therefore it is plain, that twilight is not only longer when days encreaſe in length; but it is alſo much ſtronger, as you will ſee preſently by working the Problem.

Tyro. I have heard that this Problem is very difficult in compariſon of ſome others.

Philo. It is ſomething longer in its operation, but very eaſy, if you mind the rule and the operation together.

OBSERVATION.

As you were told that twilight begins and ends when the ſun is 18° below the Horizon, and as the quadrant of altitude reaches no farther than the Horizon, therefore the rule is this.

RULE.

The globe being rectified, &c. bring the oppoſite degree of the ſun's place to the quadrant of altitude, ſo that it touches juſt 18° on the quadrant (then it is plain that the ſun's real place will be depreſſed 18° below the Horizon) then look on the index, for that will point (if among the morning hours) to the beginning, or (if among the evening hours) to the ending of twilight.

Note 1. What I mean by the oppoſite place of the ſun is this; it is that degree of the ecliptic oppoſite to, or 180 d. from the given place of the ſun. Thus, ſuppoſe the ſun was in ♈, then I bring its oppoſite ſign (viz. ♎) to 18 d. on the quadrant, ſo will ♈ be depreſſed 18 d. and the index will ſhew the hour.

Tyro. Sir, I now underſtand it very clearly.

Philo. Proceed then according to the rule, and you will find that on March the 21ſt, and September the 22d, twilight begins about 4 in the morning, and ends about 8 at night.

The ſun on theſe days, you know, riſes and ſets at 6. Add, therefore, the length of morning and evening twilight to 12 hours (the length of the days then) and it gives 16 hours, this ſubtracted from 24 hours, leaves 8 hours, the length of the real, or dark, night.

So alſo on April the 24th, twilight begins about ½ paſt 2, ends about ½ paſt 9, and laſts in all 7 hours. But on December the 20th, it begins at 6, and ends at 6, and laſts in all but 3 h. and 40 m.

Note 2. There is no real night at London (but twilight) from May the 22d, to July the 20th, the ſun all that time being leſs than 18 d. below the Horizon.

PROB. XXVI.

The hour where you are being given, to tell what hour it is in any other part of the world. See Prob. VI.

RULE.

BRING the given place to the meridian, and ſet the index at the given hour; then turn the globe till the other place, or places, come under the meridian, and the index will point to the real time in the place required.

EXAMPLE.

When it is 2 o'clock in the afternoon at London, I would know the time at Jeruſalem, and at Port Royal in Jamaica.

Proceed according to the rule, and you will find, that when it is 2 in the afternoon at London, it is 22 minutes paſt 4 at Jeruſalem; and but 52 minutes paſt 8 in the morning at Port Royal.

Another METHOD.

I told you in Problem VI. that 15° on the Equator makes 1 hour of time; therefore this Problem may be ſolved by common diviſion, for having the difference of the longitude of any two places (taken from a map) divide it by 15, the quotient is the difference of hours; and, if any degrees remain, allow 4 m. for every degree, and ſo in proportion for the odd minutes or miles.

Thus I find by Problem VI. Jeruſalem is 35° 25′ E. longitude of London; I divide, therefore, 35° 25′ by 15, and the quotient is 2 hours, and the remainder is 5, 25, which is 5 times 4, or 20 m. and the odd 25 m. or miles, is nearly 2 m. ſo that the difference is 2 hours 22 m. and as Jeruſalem is E. of London, it has its hour before us, therefore it is 22 m. after 4 in the afternoon.

Again, Port Royal is 75° 52′ W. of London; this converted into time as before is

5 h. 4 m. nearly, that Port Royal has its time later than London; for when it is noon at London, it wants 4 m. of 7 in the morning at Port Royal.

PROB. XXVII.

The day of the month being given, to tell thoſe inhabitants that will have the ſun in their Zenith (*or over their heads*) *on that day.*

OBSERVATION.

THIS cannot happen to any other inhabitants, but thoſe in the Torrid Zone, that is, to ſuch as have not above 23½ d. of latitude, either N. or S.

RULE.

Bring the ſun's place to the meridian, and obſerve exactly his declination for that day; then turn the globe any way, and obſerve what places paſs under that degree of declination on the meridian; for all ſuch will have the ſun right over their heads ſome time or other on that day.

EXAMPLE.

I would know what inhabitants, or places, will have the ſun in their Zenith on May the 21ſt.

Proceed as directed by the rule, you will find St. Domingo in Hiſpaniola, St. Jago in

Cuba, Campeachy, and many other places that will paſs under that degree of declination (viz. 20° N.) and will have the ſun in their Zenith that day.

Alſo on April the 16th, the inhabitants of Porto Bello, the Oroonoko iſlands, Bay of Siam, Iſle of Ceylon, and the Philippine iſlands, will have the ſun that day in, or near their Zenith.

PROB. XXVIII.

The day and hour being given in any place, to tell thoſe inhabitants, or that place, to which the ſun is then vertical; viz. in the Zenith.

18 1/4

RULE.

BRING the given place to the Brazen Meridian, and turn the index to the given hour; this done, turn the globe till the index points to the upper 12, or noon; then look under the degree of declination on the globe for that day, for that is the very ſpot, or place, to which the ſun is then vertical.

EXAMPLE.

On May the 13th, at 8 m. paſt 5 in the afternoon, at London, I would know what place has the ſun then in its Zenith. Anſwer, Port Royal.

N. B. There are two days in which the ſun is vertical to all the inhabitants of the Torid Zone; which muſt be when the ſun has the ſame declination, and in this Problem it will be July the 27th; viz. the ſame declination as on May the 13th.

Thus alſo will you find that, when it is 33 m. paſt 6 in the morning at London, on April the 12th, and Auguſt the 28th, the inhabitants at Candy, in the Iſland of Ceylon, will have the ſun then in their Zenith.

PROB. XXIX.

To tell the diſtance from one place to another in degrees and minutes (viz. *miles*) *in an arch of a great circle* *, *alſo their bearing, or ſituation, in reſpect of each other.*

RULE.

BRING one of the places to the meridian, and elevate the globe for the latitude of it, and fix the quadrant in the Zenith: then turn the globe till the quadrant touches the other place, and the degrees on the quadrant between place and place ſhews the diſtance; and the quadrant at the ſame time will cut the Horizon in the point of the compaſs, called the bearing, or ſituation, from the firſt place.

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* *Note*, 60 miles, or minutes, are reckoned a degree in general; but this a vulgar error; for it is proved that every degree on the earth's ſurface in every great circle (ſuch as the Equator, Meridian, &c.) is $69\frac{1}{2}$ miles;

EXAMPLE.

I would know the diſtance from London to Port Royal, Jeruſalem, and Moſcow, as alſo their ſituation in reſpect of London.

Proceed according to the rule, and you will find that from London.

	Deg.		Miles.
To Port Royal	68½	viz.	4760¾ S. W.
To Jeruſalem	33¼	nearly	2311 E. S. E.
To Moſcow	23		1598½ E.N.E.

PROB. XXX.

The latitude and day being given, to tell what time the ſun will be due E. or W.

Tyro. THIS is eaſy I think; for as the ſun is always due N. and S. at 12 at night, and at 12 at noon, I ſuppoſe he will be due E. and W. at 6 in the morning, and 6 in the evening.

Philo. I thought you would ſtumble upon this general error; but you will ſoon ſee your miſtake.

RULE.

Rectify the globe and quadrant as before directed; then turn the quadrant till it touches the E. or W. point of the Horizon;

miles; therefore, multiply the degrees by 69½, you have the diſtance in Engliſh miles.

this done, turn the globe till the ſun's place for the given day comes to the edge of the quadrant (holding the quadrant to the E. or W. point) ſo will the index point to the hour of his being due E. or W. on that day.

Proceed thus, and you will find about 5 m. paſt 7 in the morning, on May the 21ſt at London, the ſun will be due E. and about 5 m. before 5 in the evening due W. On June the 21ſt, he will be due E. about 22 m. paſt 7 in the morning, &c. but on December the 21ſt, he is due E. about 45 m. paſt 4 in the morning, and due W. about 35 m. paſt 7 in the evening.

PROB. XXXI.

To tell how many degrees of the Equator, (viz. *how many miles) are contained in a given arch of any parallel of latitude. Or, to find how many miles are contained in a degree of longitude in any latitude.*

RULE.

1. FIX the quadrant in the parallel, and obſerve how far 10, 15, or any other number, in that parallel will reach on the quadrant. Or thus, take off 10, 15, or any other number of degrees in the parallel given with a pair of good dividers, and apply that diſtance on the Equator, and obſerve how many degrees the ſame opening of

the compaſſes cut on the Equator, for ſuch is the proportion: therefore,

2. Bring the degrees that the dividers cut on the Equator into miles (in this problem it is cuſtomary to count 60 miles to a degree, becauſe it in ſome meaſure relates to navigation) and divide that product by the number of degrees in the parallel, be it 10, 15, &c. and the quotient gives the anſwer.

EXAMPLE.

I would know how many miles (allowing 60 to a degree) are contained in the parallel of latitude 52.

I take 10 d. in the parallel of latitude 52, and apply the diſtance to the Equator, and find it cuts 6$\frac{1}{6}$; viz. 6 d. 10 m. or, I take 15 on the parallel, and find it cuts 9$\frac{1}{4}$ or 9 d. 15 m. Then I multiply 6$\frac{1}{6}$ by 60, and divide by 10, it gives 37; or I multiply 9$\frac{1}{4}$ by 60, and divide by 15 (that I took off) in the parallel, and it alſo gives 37 miles, which are contained in 1 d. in the parallel of latitude 52.

Proceed after the ſame manner by taking off 10, 15, &c. degrees in any parallel, and apply it to the Equator, you will have the miles in that parallel, according to this problem. Thus you find that in the

Latitude		Miles.	
15	there contains about	58	to 1 degree.
30		51	56 m.
45		42	24
60		30	
75		15	32
90		00	

PROB. XXXII.

To find the Antœci *to any place.*

See Antœcians, Dialogue VI. Sect. IV. Article I.

RULE.

BRING London (or the given place) to the meridian, and count from the Equator on the meridian ſouthward the ſame number of degrees of S. latitude, as London has N. (viz. 51° 32′) and cloſe to the edge of the meridian make a dot, for that is the place of the Antœci to London.

PROB. XXXIII.

To find the Pericœci *to* London, *or any other place.*

See definition of Pericœcians, Dial. VI. Sect. IV. Article II.

RULE.

BRING London to the meridian, and turn the globe till 180° of the Equator paſs from London under the meridian; then under the ſame latitude as London (viz. under 51° 32′ N. at the edge of the Brazen Meridian) make a dot, for that is the place of the Pericœcians required.

PROB. XXXIV.

To find the Antipodes *to* London, *or any other place.*

See definition of Antipodes, Dial. VI. Sect. IV. Article III.

RULE I.

BRING London to the meridian, then the degree in the Nadir (viz. 38½ d. from the S. pole) is the place of the Antipodes to London.

OR, II.

Bring London to the meridian, and turn the globe till 180° paſs through the meridian, then count 51° 32′ ſouthward on the meridian, and under it make a dot, for that is the place of the Antipodes.

Or rather thus:

Bring London to the meridian, then ſlip the globe in the notches of the Horizon; viz. depreſs the pole, till London lies at the N. verge of the Horizon, juſt at the edge of the meridian; then at the S. point of the Horizon, cloſe to the meridian, make a dot, for that is the place of the Antipodes of London, which you will find to be in the Great South Sea 51° 32′ S. latitude, 180 longitude.

Thus alſo the place of the Antipodes to Cape Antonia in South America, is the bay of Nankin in China. And the place of the Antipodes to Barbadoes, is a little ſhoal in the ſtreights of Sapy.

N. B. By bringing two places thus to the Horizon, which are Antipodes, you may in a great meaſure judge of the cauſe of eclipſes; for the places are diametrically oppoſite to each other, and you may imagine the ſun to be one place, and the moon another.

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PROB. XXXV.

The longeſt day in any latitude being given (ſuppoſing London 16½ *hours) to tell in what other latitude the longeſt day is* 1, 2, 3, &c. *hours longer than in the given place.*

RULE.

REctify the globe for the given latitude (viz. London) and bring the ſolſtitial colure (viz. ♋) to the meridian; then where the Horizon cuts the tropic of ♋, make a dot on the tropic at the verge of the Horizon: this done, turn the globe weſtward, till 7½ d. of the Equator paſs under the meridian, and then make a ſecond dot on the tropic againſt the Horizon as before; then turn the globe back to its firſt poſition (viz. to ♋) and then elevate the pole, till the 2d dot appears at the edge of the Horizon; and the Horizon will cut the meridian in the latitude required.

Proceed as above, and you will find that in the latitude 56° 20′, the days are 1 hour longer than at London, which you may eaſily prove by Prob. XVI.

2. If you want to know the latitude where the day is two hours longer than at London, proceed as before, only inſtead of cauſing 7½ d. to paſs under the meridian, you muſt now turn the globe till 15° paſs under the meridian, and make then a 2d dot on the tropic.

3. If you want for 3 hours longer, make 22½ d. paſs through the meridian, and proceed as before; and thus for every hour, cauſe 7½ d. more to paſs under the meridian.

Note, If you want to know the latitude where the longeſt day is an hour ſhorter than at London, only turn the globe eaſtward, inſtead of weſtward, till 7½ d. paſs through the meridian, and make a prick on the tropic, and depreſs the pole till this lies even with the Horizon, you will find the latitude about 45½ d. Thus for two hours longer about 60°, for 4 hours about 64° 20′; but for 2 hours ſhorter the latitude is about 35½ d. This problem ſhews you the difference of climates.

PROB. XXXVI.

Any time not exceeding 6 months given, to tell that latitude, or thoſe places, where the ſun will not ſet for all that time.

Note, That 28 days are here reckoned to the month. Bring the given time into days, and take the ½ of the number of days; but remember to abate 1 if the ½ exceeds 30. Then count from Cancer on the ecliptic the ſame number of degrees as the ½ amounted to, and where this reckoning ends make a dot on the ecliptic. Laſtly, Bring this dot to the meridian, and as many degrees as are intercepted, or lie, between the dot and the pole itſelf, counted on the meridian, is the latitude required.

EXAMPLE.

I Demand the place, or latitude, where the ſun does not ſet for the ſpace of 4 months 16 days.

This is 128 days, the ½ is 64°, abate 1° is 63°; this I count from ♋ on the ecliptic, and make a dot, and bringing it to the meridian, I find there are nearly 80° between the dot and the pole; viz. the latitude is 80°, which is at Smith's Inlet, the upper part of Greenland.

So alſo in the latitude of 85°, he ſets not for 5 months, 2 weeks. And in the latitude of 86½ d. not for 5 months, 3 weeks, and 3 days; and in the latitude 90, not for 6 months; viz. from March the 21ſt to September the 22d.

Tyro. This appears, now, very plain to me, but I know the generality of perſons believe it to be falſe, for want of conſideration.

Philo. You ſee it is evident, for under the pole, in the latitude 90, when the ſun enters ♈, he begins to riſe, and does not ſet with them till he enters ♎; viz. for 6 months.

Tyro. I ſee it, Sir, very clearly; but, pray, have they not alſo a great ſhare of twilight? And are not the inhabitants at the contrary pole in darkneſs for a long time?

Philo. Yes, and ſo are the inhabitants in the N. part, when the ſun is in the tropic of ♑.

♑. This is plainly demonſtrated by the next Problem.

PROB. XXXVII.

To tell in the latitude 90 (where the longeſt day is 6 months) how long it continues to be twilight after ſun-ſet; and how long their night is after twilight ends, before it begins again.

RULE.

YOU remember, according to the laſt Problem, the ſun ſets with the inhabitants at the N. pole, and riſes to thoſe of the S. pole, on September the 22d: therefore twilight begins with them at the N. pole on September the 22d. Thereſore,

RULE.

1. Elevate the pole to the Zenith, and turn the globe, till ſome degree of the ſun's place in the ecliptic lies under 18° of the meridian, under the S. part of the Horizon, and you will find it 24° ♏; viz. November the 14th, the ending of twilight, that is, they have twilight from September the 22d, to November the 14th, and then they begin to have dark nights (ſave the advantage of the moon) till the 24th of January. For,

2. Turn the globe till ſome other point of the ecliptic comes under 18° as before, and you will find it about 5° of ♒, which an-

ſwers to the 24th of January, the beginning of twilight to the inhabitants at the N. pole, and then on March the 21ſt, he riſes with them.

Thus it appears, that the length of their day (from ſun-riſing to ſun-ſetting) is from March the 21ſt, to September the 22d. The length, or continuance, of twilight, is from September the 22d, to November the 14th, and from January the 24th, to March the 21ſt, in all about 110 days, and their real night is from November the 14th, to January the 24th; viz. about 71 days.

Note, The ſame holds good as to the inhabitants of the S. pole; for he riſes with them when he enters ♎, and ſets with them when he comes to ♈.

Tyro. I perceive it plainly, Sir; and thank you for this plain demonſtration.

Philo. Now, *Tyro*, I ſhall ſhew you the uſe of the celeſtial globe; and after that give you ſome Problems, with the practical uſe of both globes.

Here follow ſome Problems on the celeſtial globe.

Mids.r 1769.

PROB. XXXVIII.

The day of the month being given, to find the ſun's place in the ecliptic.

See Problem VII.

PROB. XXXIX.

This is the reverſe of the laſt, and done the ſame way as Prob. VIII.

PROB. XL.

To find the declination of the ſun on any day of the year.

The ſame as Problem X.

PROB. XLI.

To find the ſun's right aſcenſion.

See Prob. XVII.

PROB. XLII.

To tell the ſun's oblique aſcenſion and deſcenſion in any latitude, and on any day.

The ſame as Prob. XVIII.

PROB. XLIII.

The latitude and day being given, to find the ſun's aſcenſional difference.

The ſame as Prob. XIX.

PROB. XLIV.

The latitude and day of the month being given, to tell the ſun's amplitude; viz. *his diſtance from the* E. *and* W. *points at riſing and ſetting.*

The ſame as Prob. XX.

PROB. XLV.

The latitude and day being given, to tell the ſun's Azimuth.

The ſame as Prob. XXI.

PROB. XLVI.

The latitude and Azimuth *being given, to tell the day, ſuppoſing it were loſt.*

See the rule, Prob. XXII.

PROB. XLVII.

The latitude, day, and hour being given, to tell the ſun's almacanther.

See the rule, Prob. XXIII.

PROB. XLVIII.

To find the right aſcenſion of any ſtar.

RULE.

BRING the ſtar to the meridian, and the degree of the equinoctial, cut by the meridian, is the right aſcenſion required.

Thus you will find the right aſcenſion of Aldebaran in Taurus, to be about 65°, Arcturus in Bootes, about 210° 45′, Regel in Orion, about 75° 30′, and Sirius, or the Dog-ſtar, about 98 d. &c. &c.

PROB. XLIX.

The latitude being given, to tell the oblique aſcenſion and deſcenſion of any ſtar.

RULE.

REctify the globe, and bring the ſtar down to the eaſtern verge of the Horizon, and the degree of the equinoctial, that is then cut by the Horizon, is the oblique aſcenſion required. Turn the ſtar to the weſtern ſide, and the degree of the equinoctial, cut by the ſtar, is the oblique deſcenſion.

Proceed thus, and you will find the oblique aſcenſion of Regel to be about 86° 30′, of

Marhal in Pegaſus, about 325°, and of Aldebaran, or the Bull's Eye, about 43° 30′. Turn each of theſe to the weſtern ſide, you will find their oblique deſcenſion 54°, 360° nearly, and 87 degrees.

Note. There is this difference between the right and oblique aſcenſion and deſcenſion of the ſun and ſtars, that the ſun's oblique aſcenſion, &c. differ every day in the ſame latitude; but the ſtars oblique aſcenſion is every day the ſame.

PROB. L.

To tell the declination of the ſtars.

RULE.

As for the ſun's place, ſo alſo here, bring the given ſtar to the Brazen Meridian, and obſerve what degree of the Meridian lies right over the ſtar, for that is the declination either N. or S. according to which ſide of the equinoctial it lies on.

Thus you will find the declination of Aldebaran to be about 16° 45′ N. The upper pointer to the pole (in Urſa Major) about 63½ d. and the lower one nearly 58½ d. but Regel in Orion I find about 8¾ d. S. and Cor Scorpionis about 26 d. S. declination, &c. &c.

From this Problem and the XLVIIIth ariſeth

PROB.

PROB. LI.

The right aſcenſion and declination of any ſtar being given, to find the ſtar at once.

BRING the given degree of right aſcenſion on the equator to the Brazen Meridian, then look under the degree of declination on the Meridian, and you will find the ſtar at the Meridian, under the given degree of declination.

Thus, ſuppoſe I wanted to find Aldebaran, whoſe right aſcenſion is 65°, and his declination 16° 45′ N. I firſt bring 65° of the equinoctial to the Meridian; and looking under 16° 45′ N. declination on the Meridian, I find Aldebaran.

So alſo Sirius has 98° right aſcenſion, and 16° 30′ S. declination; therefore I bring 98 d. of the equinoctial to the Meridian, and looking under 16° 30′ S declination on the Meridian, I find Sirius juſt at the Meridian. The ſame for any other ſtar.

PROB.

PROB. LII.

To tell the riſing and ſetting of the ſtars, and the point of the compaſs any ſtar riſes or ſets upon in any latitude, and on any day of the year.

RULE.

REctify the globe, and bring the ſun's place to the Meridian; then turn the globe till the given ſtar comes to the eaſtern verge of the Horizon, and the index will point to the time of riſing, and the Horizon will ſhew the point it riſes upon: turn it to the Weſt, and the index will point to the time of ſetting, and the Horizon will ſhew you the point it ſets upon.

Proceed thus, and you will find that Aldebaran, on November the 5th, at London, riſes a little paſt 6 in the evening, and ſets about 9 in the morning. The point he riſes upon is E. N. E. and the point he ſets upon is W. N. W. But Regel in Orion, the ſame night, riſes a little before 9 at night, and ſets about ½ paſt 7 in the morning. The point of riſing is E. by S. and of ſetting W. by S.

Note. The ſtars riſe and ſet every day on the ſame point of the compaſs, though at contrary hours.

PROB. LIII.

To tell the time; viz. *how many hours any ſtar continues above the* Horizon, *from its riſing to its ſetting, in any latitude.*

RULE.

RECtify the globe, then bring the ſtar to the eaſtern verge, and note the time of riſing; then turn the globe to the weſtern ſide, and the number of hours that paſſed through the dial-plate tells you the continuance of that ſtar above the Horizon.

Thus, I find Aldebaran at London continues up from the time of his riſing on any day (but for example take December the 25th) about 15 hours, and Regel about 10½ hours.

At Stockholm Aldebaran continues up above 16 hours; but at Port Royal he continues up but about 12¾ hours.

PROB. LIV.

To tell the diſtance of one ſtar from another in degrees and minutes, in the arch of a great circle.

IN this Problem are three variations; 1. If the ſtars lie under the ſame Meridian, bring them to the Brazen Meridian, and the degrees intercepted between them, counted on the Meridian, is the diſtance required.

Thus, I find, the two pointers in the Great Bear to be about 5½ d. diſtant from each other; and Eridef and the Dolphin's Eye about 29½ d. diſtant.

2. If they lie under the ſame declination, bring the firſt (at pleaſure) to the Brazen Meridian, and note the degrees cut by the Equator: then bring the other to the Meridian, and note how many degrees have paſſed through the Meridian, for theſe ſhew their diſtance required.

Thus, I find, the difference between Aſſengue and Caput Meduſæ to be about 122½ d for Aſſengue (38½ declination) being brought to the Meridian, cuts the Equator in 277° 30′, viz. 82° 30′ from ♈ weſtward; and Caput Meduſæ cuts 40° of the Equator eaſtward; their diſtance, therefore, is 122° 30′.

3. If the ſtars neither lie under the ſame Meridian, nor have the ſame declination, then bring either of them to the Meridian, and elevate the pole to the ſame height as the ſtar has declination (that is, the ſame as you elevate the terreſtrial globe to the latitude of a place) for then the ſtar will be in the Zenith; then fix the quadrant to the Zenith, over the given ſtar, and extend it to the other ſtar, and the degrees on the quadrant ſhew the diſtance required in a true arch of a great circle. *Note.*

Note. Though the diſtance of the ſtars from each other is thus determined in degrees, yet you are not to ſuppoſe their diſtance is ſo many degrees to be converted into Engliſh miles; but it only means, that they appear ſo far diſtant under ſuch an angle.

Thus, I find the diſtance between Capella and Cor Hydræ to be about 79d. and between Aldebaran and Sirius about 46°. 30′, &c.

4. If the ſtars be at ſuch a diſtance from each other, that the quadrant will not reach them, then bring either of them to the Horizon, and elevate, or depreſs the pole, till the other lies alſo at the verge of the Horizon, and the degrees counted upon the Horizon, between ſtar and ſtar, is their diſtance in degrees.

Thus, between Aldebaran and Cor Scorpionis you will find about 170 degrees.

PROB. LV.

To tell what ſtars will be on, or near the Meridian, at noon and at midnight.

First, for thoſe at noon.

BRING the ſun's place to the Meridian for the given day, and all thoſe ſtars that are then under the Meridian are ſuch as are full S. or N. at noon.

2. Turn the globe till the index points to 12 at night (viz. the lower 12) and all thoſe

ſtars that are then under the Meridian are the ſtars required.

Thus, I find, on May the 2-th, Aldebaran is on the Meridian at noon, and Cor Hydræ will be on the Meridian Auguſt the 7th at noon; but on February the 3d, Cor Hydræ will be full S. about midnight. For only turn Cor Hydræ under the Meridian, and the index will point to the lower 12; and the Meridian itſelf will cut the ecliptic in 15 d. of ♒; viz. February the 3d. 7m

PROB. LVI.

The latitude, day of the month, and height of any ſtar being given, to tell the time or hour of the night.

RULE.

REctify the globe for the latitude, &c. &c. then fix the quadrant in the zenith, and move the globe and the quadrant together, till the ſtar cuts the quadrant in the given height; and the index will point to the hour.

EXAMPLE.

On January the 21ſt (at London) in the evening I obſerved Aldebaran E. S. E. to be about 40d. high; I demand the time of this obſervation. Anſwer, A little paſt 5 in the evening. Again, on December the

25th, in the evening I obſerved Sirius to be about 15d. high, and at the ſame time Regel to be about 28½ d. high; I demand the hour. Anſw. About 10 at night; and Aldebaran is under the Meridian at the ſame time.

PROB. LVII.

To tell what ſtars never riſe, and thoſe that never ſet at London.

RULE.

1. ONLY obſerve what ſtars have above 38½ d. N. declination; for all ſuch never ſet at London, but are always above the Horizon.

2. Obſerve alſo thoſe ſtars that have above 38½ d. S. declination, for thoſe never riſe, but are always under the Horizon at London.

Thus, the pointers in the Great Bear, Arideſ in Cygnus, and many others, never ſet.

Alſo, Canobus in Argo, Navis and Pes Centauri, and many others, never riſe at London.

OBSERVATION.

1. From what you have been taught, *Tyro*, it is eaſy to conceive, that by the inhabitants under the North pole no South ſtar can ever be ſeen, nor can the inhabitants at the South pole ever ſee one of the ſtars in the other hemiſphere. But,

2. The inhabitants under the Equator have a pleaſant ſight of all the ſtars from pole to pole; for they riſe and ſet with them at right angles; therefore, no ſtar can continue above 12 hours above their Horizon.

Tyro. Sir, you have highly obliged me, and I ſee now very plainly the different aſpect of the heavens in different places.

PROB. LVIII.

To know at any time of the year (in the latitude of London*) where to find any ſtar, or tell the name of any ſtar when required.*

RULE.

RECtify the globe for the day, and turn it till the index points to the given hour, then by a quadrant take the height of the required ſtar; or, for want of it (in a common way of gueſſing) obſerve what part of the heavens it is in; viz. whether E. N. S. W. or the like, as alſo its height as near as you can gueſs: this being done, ſet the globe in due order for the day and hour, and you will find the ſame ſtar on the globe: and, by applying the quadrant, you will find the exact point of the compaſs, and the real height the ſtar then has, which, tho' not perhaps near to what you gueſſed it at, yet, if it be any noted ſtar, you may aſſure yourſelf are its real height and bearing, as there is no other ſtar of note near it about that height, and upon the ſame point.

EXAMPLE.

Walking on December 25, at 8 at night, I obſerved a bright ſtar, (as near as I can gueſs) on the S. E. point, and about 48 d. high; I would know what ſtar it is. Anſwer Aldebaran. I rectify the globe, and turn the index to the hour, and then turn the quadrant to the given point of the compaſs, and looking about 48 d. high on the quadrant, I find Aldebaran to be the neareſt bright ſtar by the quadrant on that point and at that height; therefore, I conclude it is Aldebaran.

Alſo at ¾ paſt 10, the ſame night, I ſee two very bright ſtars, one on, or near the Meridian, about 30° high, and the other near the S. E. point, and about 35° high. I demand their names. Anſwer, Regel and Procyon in Canicula.

PROB. LIX.

To tell the latitude and longitude of the ſtars.

FIRST, obſerve, whether the given ſtar be on the N. or S. ſide of the ecliptic; and if it be on the N. ſide, elevate the N. pole 66½ d. and turn the globe till ♋ and ♑ lie in the N. and S. points of the Ho-

Horizon, that is, till the ecliptic be parallel or even with the Horizon; fix the quadrant in the Zenith: then, keeping the globe ſteady, turn the quadrant till the edge of it touches the center of the ſtar, and that degree on the quadrant (viz. the altitude of the ſtar in the latitude 66½ d.) is the latitude required, and the degree of the ecliptic, cut by the quadrant, reckoned from Aries (or rather reckoned among the ſigns, as it happens) is the longitude required.

Thus you will find Arcturus in Bootes to be about 30½ d. N. latitude, and 203° longitude from ♈, or rather 23 d. of ♎. Alſo, Alcair is about 29½ d. of N. latitude, and 28 d. of longitude in ♑.

2. For any South Star.

Elevate the S. pole 66½ d. and fix the quadrant in the Zenith, and apply it to the ſtar, as before directed, you have the latitude and longitude required. Thus you will find Pes Centauri to have about 42½ d. of S. latitude, and 236 d. longitude from ♈, or rather 26 d. in ♏; and thus for any other ſtar. See Table III. Dial. VII.

PROB.

PROB. LX.

The latitude and day of the month being given (ſuppoſe December 25, *at nine at night at* London) *to ſet the globe ſo as to repreſent the face of the heavens at that time, and ſhew your acquaintance the names and poſitions of the moſt eminent fixed ſtars.*

RULE.

RECtify the globe for the latitude, and bring the ſun's place to the Meridian, and the index to 12. Then turn the globe to the given hour, viz. 9 at night, and there fix it, ſo will every ſtar on the globe (if you ſet the globe N. and S.) correſpond with, or point to, the ſame ſtar in the Heavens.

Thus (at London) I find Capella E. by S. about 75d. high; Caſtor and Pollux, one about 40, and the other about 45d. high, near the E. point. Procyon below them, to the left hand, 23d. high E. S. E. Sirius yet lower, to the left, S. E. about 10d. high; Betelgeuze higher, on the ſame point, and about 38d. high; Regel, more ſouthward, about 26d. high; Aldebaran, on the ſame point, much higher; viz. about 53 d. the Seven Stars, or Pleiades, S. nearly, about 62d. high; Mencar, S. by W. 40d. high; Arideſ, N. W. about 26d. high, &c. &c. &c.

PROB. LXI.

To tell the time of the achronical *riſing and ſetting of the ſtar.*

DEFINITION.

1. THE achronical riſing of a ſtar is when the ſtar riſes juſt at ſun-ſet.

2. A ſtar is ſaid to ſet achronically, when it ſets with the ſun.

RULE.

Bring the ſun's place, for the given day, to the weſtern ſide of the Horizon, and all thoſe ſtars that are on, or near, the eaſtern ſide of the Horizon, riſe achronically; and thoſe on the weſtern verge of the Horizon ſet achronically.

Thus I find on December the 6th, that Aldebaran riſes achronically, but it ſets achronically on May the 21ſt. Alſo Sirius riſes achronically on February the 4th, and ſets achronically on May the 14th.

PROB LXII.

To tell the coſmical *riſing and ſetting of the ſtars in any latitude.*

DEFINITION.

1. A Star is ſaid to riſe coſmically, when it riſes with the ſun.

2. A ſtar is ſaid to ſet coſmically, when it ſets at ſun-riſing.

RULE.

Rectify the globe, &c. and bring the ſun's place to the eaſtern ſide of the Horizon for the given day; then all thoſe ſtars cut by the eaſtern verge of the Horizon, riſe coſmically. The globe ſtill remaining in the ſame poſition, look at the weſtern verge, or edge, of the Horizon, and all thoſe ſtars cut by it, or that are very near it, ſet on that day coſmically.

Thus I find that Arcturus, and 2 ſmall ſtars in Hercules's Thigh, riſe coſmically, September the 25th. Alſo two ſtars in Eridanus, Aſſengue in Lyra, &c. &c. ſet coſmically. Marhal in Pegaſus, is but juſt below the Horizon, therefore may be ſaid to ſet nearly coſmical, as it will within a day or two.

For the coſmical ſetting.

Turn the globe till the ſtar comes to the weſtern ſide of the Horizon, and obſerve the degrees of the ecliptic, then cut by the eaſtern ſide of the Horizon, for that will anſwer to the day of the coſmical ſetting.

Thus Arcturus ſets coſmically June the 22d. Alſo Aldebaran ſets coſmically December the 20th.

PROB. LXIII.

To tell the heliacal *riſing, or ſetting of the ſtars.*

DEFINITION.

1. HELIACAL riſing is when a ſtar, once immerſed in the ſun's beams, gets out of them, ſo as to be ſeen at the eaſtern verge of the Horizon, juſt before ſun-riſing.

2. Heliacal ſetting, is when a ſtar once out of the ſun's beams gets into them, ſo as to become inviſible after ſun-ſet.

Note 1. This heliacal riſing and ſetting of the ſtars is different, according to their different magnitudes. For,

Note 2. Stars of the firſt magnitude are ſeen at riſing and ſetting, when the ſun is but 12° below the Horizon. Stars of the 2d magnitude are not perfectly ſeen, but when the ſun is 13° below the Horizon. Thoſe of the 3d degree, when he is 14°. Thoſe of the 4th degree of magnitude, when he is 15° below the Horizon. Thoſe of the 5th degree, when he is 16°. Thoſe of the 6th degree, when it is 17°; and the nebulous, or ſmall ones, not unleſs he is 18° below the Horizon; viz. about the beginning and ending of twilight.

RULE.

To find the heliacal riſing, the rule is, rectify the globe, and bring the given ſtar to the eaſtern verge of the Horizon; then fix the globe, and turn the quadrant to the weſtern ſide, till 12° of the quadrant touches the ecliptic; this done, note the degree of the ecliptic, that is cut by 12° of the quadrant on the weſtern ſide (for then will the real place of the ſun be depreſſed 12° on the eaſtern ſide) and that degree ſought in the calendar gives the heliacal riſing. The heliacal ſetting is found in the ſame manner by turning the quadrant to the eaſtern ſide. Thus you will find Aldebaran riſes heliacally July the 4th, and ſets heliacally May the 5th.

And Sirius the Dog Star riſes heliacally about Auguſt the 26th *.

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* *N. B.* The poets, and others formerly, uſed to reckon their Dies Caniculares, or Dog Days, from the heliacal riſing of Sirius; but they did not agree when they ended. Some reckoned them to continue 30 or 40, and others 50 days. However, in this they agreed, that the weather was very hot and ſultry for 5 or 6 weeks after the riſing of Sirius. But as it was then, ſo it is now a moſt ridiculous whim: for Sirius does not now riſe heliacally till near September, though our almanack-makers (for what reaſon I know not) continue to reckon the beginning of Dog Days

And now, *Tyro*, I will leave you a few queſtions for practice at your leiſure, in order to exerciſe you in the foregoing Problems.

PROB. LXIV.

The latitude and day given (ſuppoſe at London, November *the 5th) to tell,*

1. THE riſing and ſetting of the ſun, and the point he riſes and ſets upon
2. His meridian altitude.
3. His altitude at any hour, ſuppoſing 10 in the morning.
4. His right and oblique aſcenſion.
5. His aſcenſional difference.
6. His amplitude at riſing.
7. His Azimuth at 10 in the morning.
8. His Almacanther at the ſame time.
9. The time he is due E.
10. The length of day and night.
11. The length of twilight.
12. The length of the real night.

Days from July the 30th. But, however, it is plain that Sirius can no ways be charged with bringing this ſultry weather; becauſe 3 or 4 thouſand years hence he will not riſe heliacally till November, and then, perhaps, will be charge with bringing as much cold by the ſame rule.

13. The inhabitants to whom he will be vertical that day.
14. The very place to which he will be vertical at 10 o'clock at night at London. Alſo,
15. To tell what time Aldebaran, or any other ſtar, will riſe and ſet that night.
16. To tell alſo what time any ſtar will be due E. or W. (ſuppoſe Aldebaran) what is its amplitude at riſing and ſetting, its Azimuth at 8 at night, and the time of being full S. Alſo,
17. To tell what point of the compaſs the pointers will then be on, and what time they will be on the meridian above, and under the pole ſtar.

Tyro. You may depend, Sir, upon my trying to work theſe Problems the firſt opportunity.

Philo. Very well; ſince you delight in theſe things, I will not leave you yet, but will ſhew you ſome Problems relating to navigation and ſpherical triangles, &c.

SECT. II.

Containing ſome uſeful Problems *in navigation.*

PROB. I.

The ſun's declination, and hour when he is due E. *being given, to find the latitude,* viz. *the elevation of the pole.*

RULE.

REctify the globe to the ſame latitude as the given number of degrees of declination, and fix the quadrant in the Zenith; then convert the hours that the ſun is due E. before, or after, 6 o'clock, into degrees, and count the ſame number of degrees on the Horizon from the E. point ſouthwards, and bring the quadrant to that degree of the Horizon, ſo ſhall the degree on the quadrant that is cut by the Equator be the complement of latitude, which taken from 90°, gives the latitude itſelf, or height of the pole.

EXAMPLE.

Sailing May the 21ſt, I made an obſervation that the ſun was due E. about 7 m. paſt 7 in the morning, and his declination 20′ N. I demand what latitude I was in.

Proceed by the rule, you will find the latitude to be 51½ d. nearly.

PROB. II.

Haivng the ſun's Azimuth *at* 6 *o'clock, and declination, to find the latitude.*

RULE.

AS many degrees as are contained in the Azimuth given, ſo much elevate the pole, and fix the quadrant in the Zenith, and bring ♈ to the meridian: this done, count on the quadrant upwards, the complement of the ſun's declination to 90°, and bring that degree to the Equator, then the degree of the Horizon, cut by the quadrant, will be the complement of latitude, counted from the S. point, or elſe from the N. as it may happen, and what this ſum wants of 90° is the latitude required; or otherwiſe, the degrees counted from the other two cardinal points, either E. or W. as it may happen, will give the latitude.

EXAMPLE.

I find the ſun's Azimuth, at 6 o'clock, to be 12 d. 15 m. and his declination 20 d. 10 m. what is the latitude? Work according to the rule, and you will have the anſwer 38½ d. complement, that is 51½ d. latitude required.

PROB. III.

The ſun's amplitude and aſcenſional difference being given, to find the elevation of the pole and ſun's declination.

RULE.

RAISE, or elevate, the pole ſo many degrees as is the aſcenſional difference, fix the quadrant in the Zenith, bring ♈ to the meridian, then count on the quadrant upward the complement of altitude, and move the quadrant, till the ſame number on the quadrant cuts the Equator; the quadrant will then cut the Horizon in the degree of the pole's elevation, and the Equator in the degree of declination.

EXAMPLE.

I made an obſervation, that the ſun's aſcenſional difference was 27 d. 10 m. and his amplitude 33 d. 20 m. I demand the latitude and declination.

Proceed according to the rule, and you will find the latitude 51° 30′, and the declination 23° 10′.

PROB. IV.

The ſun's altitude E. *and his declination being given, to prove the elevation of the pole.*

RULE.

ELevate the pole to the complement of the ſun's altitude at E. and fix the quadrant in the Zenith, and bring ♈ to the Meridian, then number on the quadrant of altitude the degree of declination, and bringing the ſame to the Equator, obſerve what degree the quadrant cuts the Equator in; for its complement to 90 d. is the height of the pole.

EXAMPLE.

The ſun's declination in 20° 10′, N. his altitude at E. (at London) is nearly 26 d. I would know whether the ſuppoſed latitude (51½) agrees herewith in operation?

Here I ſubtract 26 from 90 d. and there remains 64 d. complement of altitude, and I elevate the pole accordingly, &c. Then I bring ♈ to the meridian, and cauſe 20° 10′ on the quadrant to cut the Equator, and find it nearly 38½ d. the complement of latitude required; which, ſubtracted from 90, gives 51½ d. the real latitude of the place.

PROB.

PROB. V.

The ſun's declination and amplitude being given, to find the height of the pole.

RULE.

ELevate the pole to the complement of amplitude, and fix the quadrant in the Zenith, and bring ♈ to the meridian, then count the ſun's declination on the quadrant, and bring that degree to the Equator; and the degree of the Equator, cut by the quadrant, is the latitude required.

EXAMPLE.

Suppoſe the ſun's amplitude 33° 20′, his declination 20° 10′ what is his latitude?

Proceed according to the rule, and you will find it about 51° 30′.

Tyro. I heartily thank you, ſir.

Philo. There are many other queſtions relating to navigation, which may be deduced from theſe, and performed on the globes; which you will find treated of by and by.

SECT. III.

Containing ſome practical Problems, relating to ſpherical triangles, applied in ſome meaſure to navigation, dialling, &c. by which the learner will ſee more of the nature of the doctrine of the ſphere, than he poſſibly can do by way of plane.

Note 1. That every triangle has 3 ſides and 3 angles.

2. The Perpendicular (called alſo Cathetus) ſhall be here repreſented by, or placd on, the Brazen Meridian itſelf.

3. The baſe ſhall be placed in general upon the Equator.

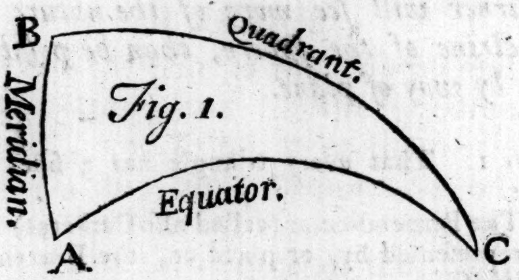
4. The Hypothenuſe (or diagonal line) is repreſented by the quadrant fixed to the Zenith, and turned to the extremities of the Perpendicular and Baſe, which will form a complete right angled triangle.

5. A right angled triangle is ſuch as has one of the angles right, or that contains 90 d. An acute angle is leſs than 90 d. and an obtuſe angle is more than 90 d. as you will ſee by Prob. V.

PROB.

PROB. I.

In the right-angled ſpherical triangle ABC, *let the perpendicular* AB *be* 42° 30′, *the baſe* AC 60° 15′. *I demand the hypothenuſe* BC.



BRING ♈ to the Brazen Meridian, and there faſten the globe: then count from Aries 42° 30′ on the Brazen Meridian, which is the perpendicular, and at 42° 30′ fix the quadrant of altitude. Then count from Aries on the Equator 60° 15′, which ſhall repreſent the baſe; and note well the degree on the Equator, or elſe make a ſmall dot. This done, turn the quadrant till the figured edge of it touches the Equator at 60° 15′; and the degrees on the quadrant from the Equator to the Zenith ſhall be the Hypothenuſe required, viz. about 68° 15′.

Note, It matters not in theſe ſort of Problems whether you elevate the pole to the number of degrees of the perpendicular; for the anſwer will be the ſame whether you do ſo, or not.

Thus you will find alſo, when the Perpendicular is 55° 45′, and the Baſe 70° 30′, the Hypothenuſe will be 79° 30′ nearly.

PROB. II.

The Baſe AC 60° 15′ *and Hypothenuſe* BC 68° 15′ *given, to find the Perpendicular* AB.

RULE.

COUNT from Aries on the Equator the baſe AC, and let the quadrant be on the Meridian, without being fixed faſt, ſo that you may ſlip it backward and forward, till 68° 15′ of it (which is the Hypothenuſe BC) juſt touches 60° 15′ on the Equator; for then will the Meridian from Aries to the nut of the quadrant tell you the perpendicular AB; viz. 42° 30′. See the figure.

PROB. III.

The perpendicular AB 42° 30′ *Hypothenuſe* BC 68° 15′ *given, to find the baſe* AC.

RULE.

COUNT from Aries on the Meridian 42° 30′ the perpendicular AB, and there fix the quadrant; then turn the quadrant till 68° 15′, on the quadrant from the Zenith, touches the Equator, and the degrees on the Equator intercepted between the point Aries, and the quadrant, ſhew you the baſe AC; viz. 60° 15′. See the figure.

Tryo.

Tyro. I underſtand the operations quite well.

Philo. I am glad of it; and it pleaſes me much to ſee you can apply things ſo well; for, as you obſerve the Horizon cuts the meridian at right angles, as well as the Equator; therefore, by counting the Perpendicular from the Horizon on the Meridian, the quadrant will ſtill be the Hypothenuſe, and will cut the Horizon at the extremity, or degree, of the Baſe, as it did the Equator before.

From hence ariſes the following obſervations.

OBSERVATION I.

The N. and S. part of the Brazen Meridian being 180° diſtant, it is plain that the quadrant of altitude fixed in the Zenith will (however extended) make two angles equal to 180°, or half the circle. For inſtance, if I lay the quadrant from the Zenith to the E. or W. points, I then have two right angles, each equal to 90°, viz. 180°; and, if I move the quadrant from theſe points, ſuppoſe 30°, to the N. or the S. I ſtill have two angles made by the quadrant, the Meridian and Horizon equal to 180°: viz. one of them equal to 120°, and the other equal to 60°.

OBSERVATION II.

From hence then it very plainly appears, that you may (by a little attention) find the meaſure of any ſide, or the angle forming any 2 ſides of a triangle; (viz. whether it be an acute angle (viz. leſs than 90°) or an obtuſe angle (viz. more than 90°;) for all the 3 angles together are always equal to 2 right angles; viz. 180°, as in the laſt obſervation.

Tyro. I am ſtill more highly obliged to you, Sir, for this clear demonſtration.

Philo. I ſhall then leave it wholly to your conſideration and practice, as it is ſo plain and obvious, and proceed to an uſeful application of Prob. I.

PROB. IV.

A ſhip ſails from N. *latitude* 55 *d.* 45 *m. in a direct courſe, till ſhe comes to the* Equator, *and her difference of longitude is* 76 *d.* 30 *m.* E. *from the place whence ſhe departed: I demand the rhumb in navigation ſhe is then upon, and the diſtance from the place ſhe ſailed from, allowing* 60 *miles to a degree, and her diſtance in an arch of a great circle, viz.* 69½ *miles to a degree?*

Note, See the operation at the end of Problem I. which is 69½d. nearly; allowing then 60 to a degree, it is 4770 miles; but at 69½ to a degree, is 5525 miles 1 quarter.

PROB. V.

Two ſhips, B *and* C, *are in the latitude* 51½ d. N. *and in* 18° W. *from* London, *from which place they ſet ſail*; B *goes* S. W. *by* W. 51° 30′, *and* C *ſails* E. S. E. 30° 30′. *I demand,*

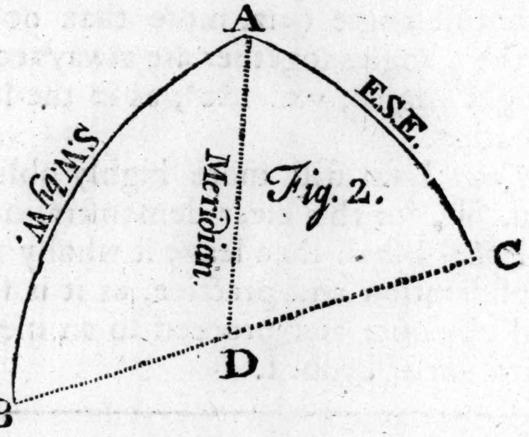


Fig. 2.

1. *The rhumb (from the N.) each ſhip ſailed upon.*
2. *The angle they make at ſetting out.*
3. *Their difference of longitude from the place they ſet out from.*
4. *Their diſtance and ſituation from each other. And*
5. *The places they arrive at.*

1. THE globe rectified, and ♈ brought to the meridian, turn the quadrant from A the Zenith, till it cuts the S. W. by W. point, and at 51° 30′ from A upon the quadrant, make a dot on the globe, which will repreſent the place where the ſhip B is, viz. the 11th rhumb from the N. point, which is arrived nearly at Barbadoes.

2. Turn the quadrant to the E. S. E. point, and on the quadrant from A, count 30° 30′, and make another dot on the globe, which repreſents the place of the 2d ſhip C (which lies off from Tripoly by Cape Meſurata in the Mediterranean) and the quadrant cuts the Horizon in the 10th rhumb from the N. point.

3. Obſerve what angle the quadrant cuts the Horizon in, counted from the S. point, or meridian, A D itſelf, and you will find that B A D is 56° 15′ and D A C is 63° 30′, the angle the 2d ſhip makes with the meridian at A.

4. Add theſe two angles together, and they will ſhew the whole angle that A makes with the Horizon B D C, viz. 119° 45′.

5. Bring the place each ſhip is in to the meridian ſeparately, it will ſhew you the difference of their meridian from the firſt ſetting out; viz. their difference of longitude: that B will be found to have made 41 d. 15 m. of W. longitude, and C 34 d. 15 m. of E. longitude from the place of departure. Their difference of longitude is 75 d. 30 m.

Laſtly, For their diſtance, bring either of the ſhips (ſuppoſe B) to the meridian, and elevate the pole accordingly, and fix the quadrant in the Zenith, and extend it to the 2d ſhip, or dot C, on the globe, and you will find it about 70 d. 14 m. N. E. by E. of B. the diſtance required; which multi-

plied

plied by 60, gives 4245 miles, and 69½, gives 4917 miles nearly.

Tyro. I could not have thought the uſe of that little appendant, the quadrant, had been ſo extenſive; for, I perceive plainly now, that when the quadrant is fixed in the Zenith, it always makes 2 angles, which together make 180 d. Thus, if I turn it right to the E. point, I have 2 angles, called right angles, each of which is 90 d. viz. 180 d. If I turn it any where elſe at pleaſure, ſuppoſe to the E. N. E. point, I then have 2 angles, viz. the Zenith from the N. point itſelf, to the E. N. E. point, which is 67 d. 30 m. called an acute angle, or leſs than 90 d. and the other angle from the S. point, to the E. N. E. is 112 d. 30 m. which is 22 d. 30 m. more than 90 d. or a right angle, and is therefore called an obtuſe angle.

Philo. I am glad to ſee you can apply ſo happily what I have ſhewn you. I ſhall, therefore, ſhew you how to make a common dial, from whence you will naturally ſee the properties of the ſphere more plainly, and by the interſection of the different circles, will yourſelf be able to raiſe many curious and uſeful Problems.

PROB. VI.

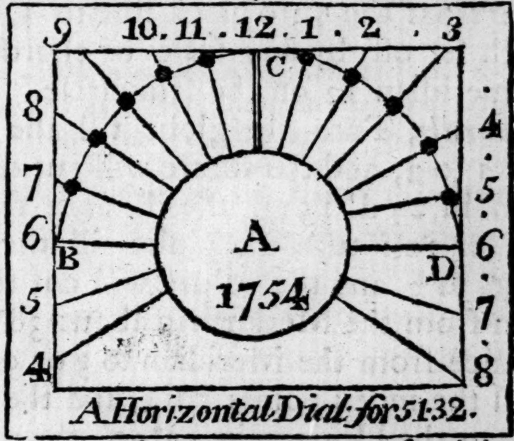
To make an horizontal dial (viz. a dial to be ſet upon a poſt, or pedeſtal) in any latitude; but ſuppoſe for London.

EX-

EXAMPLE.

LET it be required to make an horizontal dial for the latitude of London.

Firſt, Take a piece of braſs, or a thick ſmooth painted piece of board, of the ſame ſize as that of which you would have your dial; and deſcribe upon it, a ſemicircle at pleaſure from the centre A, as B, C, D.



A Horizontal Dial for 51.32.

Secondly, Divide this ſemicircle into two equal parts by the line A 12.

Thirdly, Draw the right lines by the extremity of the ſemicircle, ſo as to form the tangents to it at B C and D, to contain the hour lines; and thus is your plane, or dial, ready to have the hours drawn from the center.

Now to find the diſtance from the meridian, or 12 o'clock line, in degrees or minutes.

RULE I. is,

Bring the vernal colure (viz. ♈) to the meridian, and the index to the upper 12; this

this done, turn the globe weſtward, till the index points to 1 o'clock; (or till 15 degrees paſs through the meridian) and you will find the colure (viz. the line that paſſes through Aries from pole to pole) to cut the Horizon in 11 d. 40 m. from the meridian, the diſtance from the 12 o'clock line to 1, or 11, which ſet off by any ſcale of chords from the meridian 12 on the ſemicircle.

Secondly, Turn the globe till the index points to 2, and the colure will cut the Horizon in 24 d. 15 m. the diſtance from 12 to 2 or 10: turn the globe till the index points to 3, and the colure will cut the Horizon from the Meridian in about 38° 5′ the diſtance from the Meridian to 3 or 9: turn it till the index points to 4, and the colure will cut the Horizon in 53° 30′, the diſtance from 12 to 4 or 8. Turn it till the index points to 5, and the colure will cut the Horizon in 71° 4′ the diſtance from the Meridian, or 12 o'clock line, to 5 or to 7. The 6 o'clock line will be 90°, or fall in the arch C D in the point D, viz. the colure will cut the Horizon at 90°, or in the eaſt point.

Thirdly, Take off theſe degrees and minutes from any ſector or ſcale of chords; and ſetting one foot of the compaſſes in C, ſet off on the circle from C towards B and D 11° 40′, 24° 15′ &c. &c.

Fourthly, From the center A draw lines through theſe dots or pricks, to the tangents or lines without the ſemicircle, and you have the true hour lines.

Note 1. The halves and quarters are found the ſame way, by turning the globe till the index points to ½ paſt 12; ½ paſt 1, &c. and obſerving in how many degrees the colure cuts the Horizon from the Meridian.

Note 2. After you have drawn the hours from 12 to 6 in the morning, and 6 in the evening, you may eaſily get the hours at 5 and 4 in the morning, by laying a ruler from the hours of 5 and 4 in the afternoon, and drawing lines through the center. The ſame may be done on the other ſide of the plane, that is, lines drawn from 7 and 8 in the morning, will be 7 and 8 at night.

Note 3. The ſtyle or gnomon of this dial makes an angle with the 12 o'clock hour line of 51d. 32m. and muſt be put in the center A, and ſtand directly over the 12 o'clock line, or meridian of the plane.

☞ *Note*, Always remember to make an allowance for the thickneſs of the ſtyle or gnomon on the plane, by drawing two lines by the ſide of the Meridian line, as wide as the ſtyle is thick.

PROB. VII.

To make a direct S. *dial in the latitude of* London.

There are two ways.

FIRST, let the globe remain for the latitude of London as before, and fix the quadrant in the Zenith, and turn it to the E. point, or to the W. and there fix it: then turn the globe to 11 o'clock or to 1, and the colure will cut the quadrant in 9° 30′.

Turn it to 10 or 2, the colure will cut the quadrant in 19 d. 32 m. the diſtance from the Meridian.

Turn it to 9 or 3, it cuts the quadrant in 32 d. 10 m.

Turn it to 8 and 4, it cuts in 48 d. 5 m.

Turn it to 7 and 5, it cuts it in 67 d.

Or,

2. Elevate the pole to the complement of London's latitude 90, viz. to 38½ (for 38½ and 51½ make 90) then turn the globe till the index points to 11 or 1, and the colure will cut the Horizon in 9 d. 30 m. turn it to 10 or 2, the colure will cut the Horizon in 19 d. 32 m. &c. as before.

Tyro. Sir, I am extremely obliged to you, but if it were not too much trouble, I would deſire you to give me one example how to make a vertical dial that declines from the S. either eaſtward or weſtward; for you know that it is a chance indeed that a wall ſhould exactly face the ſouth.

Philo. I am ready to do every thing, *Tyro,* that lies within the compaſs of time, room, and ability. We will ſuppoſe then it were required as follows; viz.

PROB. VIII.

To make an erect, or vertical dial, declining from the North towards the Eaſt or Weſt.

EXAMPLE.

Let it be a dial declining from the N. *eaſtward* 60 *d.*

RULE.

RULE.

1. REctify the globe, quadrant, colure, and index, as before.

2. Bring the quadrant of altitude to cut the Horizon in the degree of declination; viz. 60 d. from the N. point, eaſtward, which repreſents a plane, declining that number of degrees.

3. Hold the quadrant faſt at 60 d. and turn the globe eaſtward, till the index points to all the forenoon hours, and the colure will cut the quadrant on the number of degrees each hour is diſtant from the Meridian; and lines drawn through each of theſe from the center, are the hours required.

Thus to find the forenoon hours.

I turn the globe till the index points to 11, 10, 9, &c. or till 15 d. of the Equator paſs through the Meridian, and I find the colure cuts the quadrant (from the Zenith) as follows.

		d.	m.
11	o'clock	9	30
10	———	18	15
9	———	26	12
8	———	35	5
7	———	45	10
6	———	57	20
5	———	76	00

The forenoon hours required, which will be on the W. or left-hand ſide of the 12 o'clock line, becauſe the plane declines eaſtward, and conſequently you have more hours in the forenoon than in the afternoon on this plane.

2. *To find the afternoon hours.*

I now turn the quadrant to the oppoſite point of the Horizon; viz. I cauſe it to touch 60 d. of the Horizon from the S. towards the W. and bring the index and colure back to the Meridian.

Then turning the globe weſtward, till the index points to 1, 2, 3, and 4, or till 15 d. paſs through the Meridian, and the colure will cut the quadrant (counted from the Zenith) as follows.

For 1	o'clock	12	45
2	———	29	45
3	———	52	45
4	———	80	15

Theſe are the diſtances of the afternoon hours, from the 12 o'clock hour or meridian. Here you ſee the colure goes off the quadrant; therefore the ſun goes off this plane about 4.

3. *To find the diſtance of the ſubſtyle or place of the gnomon from the* 12 *o'clock line, as alſo the height of the ſtyle; do thus:*

Bring the colure to the Horizon in the plane's declination, counted from the S. towards the E. viz. bring the colure to 60 d. in the Horizon, counted from the S. eaſtward;

ward; and then turn the quadrant till that touches the ſame number of degrees (viz. 60 d.) from the N. eaſtward; ſo ſhall the quadrant and colure cut each other at right angles; and the number of degrees counted on the quadrant from the colure to the Zenith are the degrees of the ſubſtyle's diſtance, viz. 21° 40′; and the degrees from the pole to where the quadrant cuts the colure, counted on the colure, is the height of the ſtyle, viz. 32° 45′.

Laſtly, Meaſure or take off 21° 40′ from any ſcale of chords, and ſetting one foot at the 12 o'clock line, turn the other weſtward, or to the left hand, and make a dot or prick; for right over this dot muſt the ſubſtyle or gnomon ſtand.

And thus by a little attention may any ſort of declining, inclining, or reclining dials be eaſily made by the globe. For a direct S. dial at London will be an Horizontal dial to the inhabitants of 38° 28′ S. latitude; viz. 90 d. diſtance from our Zenith.

So an erect plane under the pole is an horizontal one under the Equator. An erect vertical at 80 d. N. latitude, will be a horizontal in 10 d. S. latitude, &c. &c.

Tyro. Sir, I heartily thank you; for this gives me a clearer notion of the poſition of places and planes than I had before. But, pray, may not ſome Problems relating to the moon be performed by the globes?

Philo. Yes; the very ſame way as thoſe relating to the ſun, when once you know her place in the ecliptic; but this you muſt find very often, becauſe it is continually changing, and indeed is ſo variable, that the operation will not ſtand long, or hold good but for that day only: but by getting her true place, you may tell her riſing, ſetting, and ſouthing, the hour of the night, the time of high water, &c. &c.

I will give you a ſmall notion of it, and leave the reſt to exerciſe your own ingenuity. Divide the equinoctial into 30 equal parts, by red ſtrokes or figures, beginning at Aries, and at every 12th degree making a mark, as 1, 2, 3, 4, &c. this repreſents the 30 days of her age.

Now to find her place. Elevate the N. pole to the Zenith, and bring the equinoctial colure againſt the day of the month in the Horizon, ſo ſhall the moon's age (wrote in red figures) on the equinoctial, point to the degree ſhe is in at that time.

Tyro. I am extremely obliged to you, Sir, for all theſe favours; but, as neceſſity obliges me to go, I beg you would excuſe me, and receive my hearty thanks.

Philo. My dear pupil, I wiſh you well, and would adviſe you to employ your time in the practice of theſe things, rather than ſpend it in trifles and idleneſs.

Tyro. Sir, I thank you for your good advice, and am your humble ſervant.

Philo. Farewel.

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APPENDIX:

CONTAINING,

A ſhort Account of the Solar Syſtem, and of the Comets, and fixed Stars.

DIALOGUE I.

Between PHILO, *a Tutor, and* TYRO, *a Pupil, concerning the* Solar Syſtem.

Tyro. THough you have given me ſome notion of aſtronomy in the ſeveral problems you have ſolved relative to the ſun and ſtars, yet, as I have heard many things concerning the ſolar ſyſtem, and the comets and fixed ſtars, which I do not underſtand, I would take it as a particular favour if you would give me a more full and circumſtantial account of theſe heavenly bodies.

Philo. I will, my dear *Tyro*; but you muſt be content with a ſhort account indeed: for to give you a full account of all theſe particulars would greatly exceed the limits of this little Treatiſe, and ſtill more, the bounds to which I am confined in this ſhort Appendix. By the ſolar ſyſtem, then, you are to underſtand the ſun, which is placed in the center, together with the ſix planets, Mercury, Venus, the Earth, Mars, Jupiter, and Saturn, which move round him. Theſe planets, with reſpect to their nearneſs to the ſun, are exactly in the order in which they are here mentioned. Mercury is neareſt to the ſun, Venus next, the Earth next, Mars next, Jupiter next, and Saturn is at the greateſt diſtance of all. The diſtances of the planets from the ſun may eaſily be conceived in the following manner: ſuppoſing the diſtance of the earth from the ſun to be divided into 10 equal parts, then that of Mercury will be 4 of theſe parts; that of Venus 7; that of Mars 15; that of Jupiter 52; and that of Saturn 95. Hence it appears, that the Earth is placed between Mars and Venus, having Mars, Jupiter, and Saturn above her, and Venus and Mercury below her; and for this reaſon it is, that the three firſt are called ſuperior, and the two laſt inferior planets. But to expreſs the diſtances of the planets from the ſun as nearly as poſſible, in Engliſh miles, the diſtance of Mercury from it is 36,841,468 miles; of Ve-

nus,

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nus, 68,891,486 miles; of the Earth, 95,173,000 m.; of Mars, 145,014,148 m.; of Jupiter, 494,990,976 m.; and of Saturn, 907,956,130 m. By theſe diſtances, however, are to be underſtood their mean diſtances; in order to comprehend which, it muſt be obſerved, that the orbit, or path, which a planet deſcribes about the ſun, is not a perfect circle, but a figure called an ellipſis; which, though ſomewhat reſembling a circle, is longer than it is broad. Hence the ſame planet is not always at the ſame diſtance from the ſun, and the mean diſtance of it is that which is exactly between its greateſt and leaſt diſtance. The planets appear at firſt ſight like the fixed ſtars; but, upon a more accurate view, they may eaſily be diſtinguiſhed from them. 1. By their never twinkling, as theſe laſt do. 2. By their being ſeen earlieſt in the evening, and lateſt in the morning. And 3. By their changing their poſition with regard to the fixed ſtars, and to one another; but always keeping within the ecliptic, that is, within 23½ degrees of the Equator, either ſouth or north. Mercury is ſo near the ſun, that he can ſeldom be ſeen without the help of glaſſes. Venus is eaſily known, being ſometimes the evening, and ſometimes the morning ſtar; and Mars, Jupiter, and Saturn appear of a more red or fiery colour than the fixed ſtars.

Tyro. Do all theſe planets perform their revolutions round the ſun in the ſame time?

Philo. No; that is not likely, conſidering their different diſtances from him. Mercury performs his revolution in about three months; Venus in about ſeven months and a half; the Earth in a year; Mars in about two years; Jupiter in twelve, and Saturn in about thirty years.

Tyro. Are all the planets of the ſame bulk or magnitude?

Philo. No: the Earth is 27 times as big as Mercury, very little bigger than Venus, 5 times as big as Mars; but Jupiter is 1049 times as big as the Earth, Saturn 586 times as big, excluſive of his ring; and the ſun is 877,650 times as big as the earth.

Tyro. You ſay the earth moves round the ſun. How can I believe that, when I plainly ſee, that the ſun moves round the earth?

Philo. You muſt naturally think ſo; but you are miſtaken; and your miſtake is eaſily accounted for from the following circumſtance, namely, that the appearance will be the ſame to you, whether the ſun moves round the earth, or the earth round the ſun. But firſt I muſt obſerve, that the earth has two motions; one round its own axis from weſt to eaſt in twenty-four hours, which makes all the heavenly bodies appear to move round the earth from eaſt to weſt in the ſame time, and cauſes the regular ſucceſſion of day and night; and the other round the ſun in the ſpace of a year, which occaſions the change of the ſeaſons. That the appearance will be the ſame if the earth turns round its axis, as if all the heavenly bodies moved round the earth, may be eaſily proved by a very ſimple experiment. Go on board a ſhip, and let her be turned gently and uniformly round, you will not be ſenſible of the ſhip's motion, but will imagine that all the objects on land are moving round the ſhip. In like manner, let one ſhip be fixed immoveably in her ſtation; go on board another ſhip at the diſtance of two or three miles: let this ſecond ſhip ſail regularly and uniformly in a circular direction round the firſt ſhip; you will not be ſenſible of the motion of the ſhip in which you are, but will imagine that the immoveable ſhip is moving round you. The firſt of theſe is an exact repreſentation of the diurnal motion of the earth round its own axis; the ſecond, of its annual motion round the ſun.

Tyro. But though theſe motions of the earth be perfectly reconcileable to appearances, it does not therefore follow, that they take place in fact.

Philo. That they do take place in fact, aſtronomers have proved by a variety of arguments, many of which are above your comprehenſion; and beſides, to mention them all, or even the principal of them, would greatly exceed the limits of this ſhort Appendix: I ſhall content myſelf at preſent with taking notice of one or two. In the firſt place, if the earth does not turn round its own axis, the ſun and ſtars muſt move round the earth in the ſpace of 24 hours. But conſidering the great diſtance of the ſun from us, if he was to go round the earth in 24 hours, he muſt travel upwards of 300,000 miles in a minute; and as the ſtars are at leaſt 400,000 times as far from the ſun as the ſun is from us, thoſe about the Equator muſt move 400,000 times as quick as the ſun. But this is a degree of velocity, which it exceeds the utmoſt ſtretch of human imagination to conceive; and indeed it ſeems to be as impoſſible to form any idea of it, as of infinite ſpace, or eternal duration. It is, therefore, natural to conclude, that the earth turns round its axis, which is eaſily conceived, inſtead of the ſun and ſtars moving round the earth, which it is impoſſible to comprehend.

In the next place, it is an eſtabliſhed law of nature, that a heavy body never moves round a light one as its center of motion. A pebble, faſtened to a mill-ſtone by a ſtring, may by an eaſy impulſe be made to circulate round the mill-ſtone; but no impulſe can make a mill-ſtone circulate round a looſe pebble, for the heavieſt would undoubtedly carry the lighteſt along with it wherever it goes. But the ſun is at leaſt 227 thouſand times as heavy as the earth; and therefore, inſtead of the ſun moving round the earth, not only the earth, but all the other planets, muſt move round the ſun as their center of motion. Beſides, if the ſun moved round the earth, it would take no leſs than 173,510 days to perform its revolution, and in that caſe our year would be 475 times as long as it now is; but as we find the regular return of the ſeaſons, that is the completion of a whole year in 365 days and 6 hours, it neceſſarily follows, that the earth muſt move round the ſun. Add to this, that, as the other planets, in their revolutions round the ſun, ſometimes move forward, ſometimes ſeem to ſtand ſtill, and ſometimes to move backward, all theſe irregularities are eaſily accounted for by ſuppoſing the earth to move round the ſun, but cannot be explained on the contrary ſuppoſition, of the ſun's moving round the earth.

Tyro. I beg leave, Sir, to mention one objection to the diurnal rotation of the earth on its own axis. If it moves, as you ſay, from weſt to eaſt, will not a ball, fired perpendicularly upward in the air, fall conſiderably weſtward of the place from which it was ſhot?

Philo. By no means: for as both the gun and ball partake of the earth's motion, the ball will be carried forward with the air as quick as the earth and air turn, and will therefore fall on the very ſpot from which it was fixed. Thus, if you let fall a ſtone from the top of a main-maſt, it will fall on the deck as near the foot of the maſt when the ſhip ſails as when ſhe is at reſt.

Tyro. Do the other planets, as well as the earth, turn round their axes?

Philo. Some of them do. Venus turns round her axis in 24 days, 8 hours; Mars in 24 hours, 40 minutes; and Jupiter in 9 hours, 56 minutes. Whether Mercury and Saturn have any revolution round their axes, is not yet known. The ſun turns round his axis in 25 days, 6 hours; and the moon round hers in 29 days, 12 hours, and 44 minutes; that is, in the ſame time that ſhe revolves round the earth, ſo that ſhe has always the ſame face turned towards the earth.

Tyro. Is not the moon one of the planets?

Philo. She is; though not a primary, but only a ſecondary planet, or ſatellite; that is, an attendant upon the earth, about which ſhe revolves as her center of motion, in the ſame manner as the earth revolves round the ſun from weſt to eaſt; and hence it is, that ſhe riſes every night conſiderably later than ſhe did the preceding one, except during harveſt, when, for ſeveral nights together, ſhe riſes, when at full, nearly at the ſame time; for which reaſon this moon is, by way of diſtinction, called the harveſt moon. When the moon is directly between the earth and the ſun, it cauſes an eclipſe of the ſun; and when the earth is directly between the ſun and the moon, it cauſes an eclipſe of the moon. The former always happens at new moon; the latter at full moon. But neither of them happen at every new and full moon; for, if they did, there would be thirteen eclipſes of each luminary in the courſe of a year, whereas there are never more than ſeven, nor leſs than two.

Tyro. Have the other planets any moons?

Philo. Jupiter has four moons, and Saturn five. Mercury, Venus, and Mars have no moons; at leaſt none that have yet been diſcovered. Saturn has, beſides, a thin broad ring (which I mentioned above) that ſurrounds his body, without touching it, in the ſame manner as a horizon does an artificial globe. It is 21,000 miles in breadth, and is as far from Saturn on every ſide.

Tyro. Is the moon as big as the ſun, as ſhe appears to be?

Philo. So far from it, that ſhe is, at leaſt, 42,875,000 times leſs that the ſun. The reaſon of her appearing as big as the ſun is, that ſhe is much nearer the earth. Her diſtance from the earth is only 240,000 miles, whereas that of the ſun is 81 millions.

Tyro. What kind of bodies are the planets?

Philo. They are dark or opaque bodies, that have no light of their own, but ſhine by the reflected light of the ſun, which is a great body of fire, and is the ſource of light and heat to all other bodies in the ſolar ſyſtem.

Tyro. Are the planets inhabited?

Philo. They probably are; for it is not to be ſuppoſed, that the Almighty created ſo many worlds for no other purpoſe, than merely to afford a faint, glimmering light to the inhabitants of this earth, eſpecially as we might have enjoyed a much greater light at a far leſs expence, namely, by the addition of another moon.

Tyro. What do you mean by the comets?

Philo. The comets are certain dark or opaque bodies, like the planets, and move round the ſun, but in very excentric orbits, being ſometimes ſo far from him, that their cold muſt be exceſſive, and ſometimes ſo near him, that their heat muſt be ſo intenſe, as would prove altogether intolerable to an inhabitant of this earth; and would even deſtroy, or at leaſt vitrify, the earth itſelf. Sir Iſaac Newton computed the heat of the comet which appeared in 1680, when neareſt the ſun, to be 2000 times greater than that of red-hot iron; and that being thus heated, it muſt retain its heat until it comes round again, although its period ſhould be more than 20,000 years; and it is computed to be only 575. The theory of comets is not as yet very diſtinctly aſcertained. There are ſuppoſed to be 21 comets belonging to the ſolar ſyſtem; but the periods or returns of three of them only are known with any tolerable certainty. One of them is expected to return in 1789. Comets are always attended with long tranſparent trains or tails, iſſuing from that ſide of them which is turned away from the ſun. Comets were formerly ſuppoſed to be prodigies or portents, and to foretel ſome great event or revolution, ſuch as the fall of empires, or the death of ſome eminent and diſtinguiſhed perſonage; but they are now known to have no more connection with the civil or political affairs of this world, than any other of the heavenly bodies.

Tyro. What do you mean by the fixed ſtars?

Philo. All the other heavenly bodies, except the ſun, planets, and comets. They are called fixed ſtars, becauſe they always keep the ſame place, or relative diſtance from one another. Their number is probably infinite; but thoſe diſcoverable by the naked eye, do not exceed 1000; and thoſe diſcoverable by glaſſes, do not amount to above 2000; in all 3000. Their appearing ſo numerous, or rather numberleſs, to the naked eye, is owing to our looking upon them in a confuſed manner, and without reducing them to order. They are ſuppoſed to be ſuns, each of them as large as ours, and to have planets, both primary and ſecondary, revolving round them. What a grand and exalted idea does this give us of the works of creation, and of the power, wiſdom, and goodneſs of the adorable Creator!

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